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ECONOMIC SURVEY OF MINERALS IN INDIA

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"THE ECONOMICS OF CHEMICAL PRODUCTION"

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PREFACE

This is just an introduction to an immense subject on minerals dealing particularly with India's economic potentialities in that field. The development of mineral resources is a subject not merely of national interest but has a great international significance. These days, the strategy of minerals is more and more being recognised all over the world. In India, too, the question of mineral exploration and their efficient production has assumed a greater importance than hitherto done.

The object of this publication is to review India's resourcefulness in mineral production and the problems connected with the disposal and utilization of important minerals. An attempt has been made to throw light on the past growth of the industry and the scope of its future development. In India, the mineral industry has been growing against odds. Occasionally, its development has been influenced by the national and international events. In recent years, the legislative measures adopted by the Government to rationalise mineral production have also been responsible for the reorientation of the industry.

To deal with the subject systematically, the volume has been split into three parts. The first part deals with the growth of industry in general, reviewing briefly the trends in mineral production grouped under broad categories and also by states, the employment in mines and the number of units in different mining industries. The second part surveys the various minerals and mineral products, describing briefly the production trends of minerals and their utilization aspect. This is a summary of facts relating to the mineral industry in India and could not be considered as an exhaustive account of the various minerals. To do full justice to the subject, it may perhaps be necessary to devote a separate volume to each one of the minerals. The various problems faced by the industry are discussed in the third part of the volume. In the end, the appendix contains statistical tables on the mineral production of certain selected countries of the world.

The publication is designed to give factual information on mineral economics and should prove highly useful to the geologists, the mining engineers, the economists and those engaged in mining and mineral trade as a reference guide in framing their programme of future development. For the students of mining and geology and those interested in the subject of economic geography it should be an indispensable handbook on minerals.

An extensive reference work of intensive nature is involved in the preparation of this manuscript. Statistical data have been extracted from numerous sources including standard reference books, the publications of the Geological Survey of India and the Indian Bureau of Mines, the Minerals Yearbooks and several journals and periodicals. The production figures for the year 1958 are generally provisional.

A. K. MADAN

19th September, 1959,
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CHAPTER I

INTRODUCTION

India occupies a significant position on the world mineral map, as in certain minerals she holds a key position. Apart from rich deposits of a few minerals, a wide range of other natural products is also known to occur in different parts of the country. Even though certain minerals deposits are exceptionally rich, yet the level at which some of those industries operate is very poor. The annual mineral production in India makes a modest contribution to the country's productive assets. In recent years, the share of minerals in the total national product has been roughly of the order of one per cent.

Before the second world war, the country made a very slow progress in the field of mineral production. In the beginning of the century, India produced annually, minerals on an average worth Rs. 6 Crores, and by 1939, the value of mineral production was Rs. 18 crores. In 1945 it was valued at Rs. 46 crores, and by 1958 the same was as high as Rs. 131 crores. On the whole, the mineral industry made a rapid progress during war years, but the real expansion of the industry took place only in the post-independence period.

India is, at present, engaged in her nation building activities. In her programme of economic construction and reconstruction, the country has, as far as possible, to depend on her internal resources. Minerals are the national assets of a country as through successful exploitation of its mineral resources, the nation is materially benefited. The mineral production directly adds to the nation's wealth. As minerals form a base for several industrial projects and some of these are also a potential source of earning a foreign exchange, the development of mining industry in the country is a matter of great national significance. The industrial and economic structure of the country is, in fact, intimately linked with her programme of mineral production. Minerals can play a vital role in strengthening country's economy.

A planned approach to exploit the country's mineral wealth can help considerably in mobilizing her internal resources.

In these days of controlled economy, the rationalization of production and consumption of minerals can result in maximum monetary gains. A high degree of efficiency is demanded in the technique of production and utilization, and that is, perhaps, the key to the conservation of mineral resources. Prior to production planning, it is desirable to study the various factors that affect production and marketing of minerals. For that purpose the appraisal of mineral resources, the geographic distribution of deposits, the size and organization of the mining industry, the technique of production, the extent of demand for minerals, the channels of distribution and the pattern of mineral consumption should form the basis of a detailed study.

In a country like India, where the distribution of mineral deposits is uneven and inequitable, thereby involving a long distance haulage of minerals, the problem of transport is pretty serious. It is really uneconomic to transport long distance, the cheap and bulky minerals. The problem of transport is particularly acute for minerals meant for export. Adequate transport and shipping facilities at a reasonably cheap cost can help in improving the competitive strength of Indian minerals in the international market.

In recent years, both the Central and State Governments have shown keen interest in developing country's mineral resources. Several legislative measures have been enforced to rationalize mining activity in the country. The Mines and Minerals (Regulation and Development) Act 1948 and the rules framed thereunder, such as the Mineral Concession Rules and the Mineral Conservation and Development Rules have brought about reforms in certain spheres of mining in the country. In April 1956 the Government of India revised its Industrial Policy of 1948 and in pursuance of that, the development of some of the strategic mining industries like that of coal, lignite, crude petroleum, iron ore, manganese ore, chrome ore, sulphur, pyrites and atomic minerals has to take place in public sector. The development of other mining industries is, however, left to care of the private sector.

To implement its programme of mineral development under the Five-year Plans, the Government of India brought about an expansion in several of their departments, particularly, the Geological Survey of India, the Indian Bureau of Mines, the Organization of Coal Controller, etc. Several new organizations, like the Oil and Natural Gas Commission, the National Coal Development Corporation, the Neyveli Lingnite Corporation and the National Mineral Development Corporation have been brought into existence. State trading in metalliferrous ores was introduced in 1956. In the same year, the Mica Export Promotion Council was set up. The gold mining industry has already been nationalized while the diamond mining is in the process of nationalization. At the same time, some of the State Governments have also strengthened their departments of mining and geology. Some of the State Governments have also sponsored certain mining development projects. Development work regarding the utilization of certain minerals is being actively pursued in some of the National Laboratories. Research investigations relating to the beneficiation of metalliferrous ores, the coal washing and the coal carbonization are of particular interest. The Railways, too, have made provision to help the mining industry by allotting more wagons for the movement of increasing mineral traffic. At certain occasions the Government have also offered other incentives to the private sector where the development of a particular industry has been in view.

In recent years, prospects of stepping up mineral production in the country both for internal consumption and for the purpose of exports have improved. To meet the increasing demand for minerals, there has been a considerable planning in the field of mineral production and for the development of some of the mining industries.

An attempt has been made to review in the following pages, the growth of the mining industry in India during the past few years. Minerals arranged in alphabetical order, describing, particularly, their production trends and the utilization aspect of some of them, are surveyed in one of the chapters, while the problems of the mining industry are discussed in another.

CHAPTER II

GROWTH OF THE MINING INDUSTRY

From early years of civilization, the Indians were familiar with the mining and metallurgy practice, but in those days it never developed into a regular industry. The mineral potentialities of the country, however, remained unknown for a long time. In the absence of any reliable indication, the existence of different kinds of minerals in the country could not be established. Hence, the question of developing country's mineral resources could not be given the due importance.

In India, the regular mining practice is hardly 60 to 70 years old. Actually, the mining activity in the country was initiated at the close of the 19th century, but, for practical purposes, the industry got a real start in the beginning of the 20th century. The industry could not make much progress, as in early years the demand for minerals in the country was limited. Subsequently, with the discovery and the opening up of several mineral deposits it has been possible to assert with confidence that India's mineral resources are, by no means, negligible and can provide a firm base for the development of several matallurgical and non-metallurgical industries in the country. With growing industrial activity in the country and with better transport facilities available, the prospects of developing country's mineral resources have considerably improved in recent years. Today, the question of developing the mining industries in the country is as important as any other industry. In fact, minerals hold a strategic importance in the country, as these continue to be the feeder raw materials for numerous processing industries.

Recent Developments

The mining industry made a slow and steady progress in the days of British Rule in India, while its growth was quite marked in the post-independence period. The exploitation of country's mineral resources was of a much higher magnitude

during the First-Plan period. Production trends of broadly grouped minerals in certain selected years in the past may be seen from TABLE No. 1 below.

TABLE NO. 1

Production of Minerals[1] (broad groups) in India.

Year	Total Rs. Millions	Per cent					
		Total	Coal	Ferrous	Non-Ferrous	Non-Metallic	Building materials
1935[2]	181	100.0	35.9	5.5	38.1	17.1	3.3
1940[2]	183	100.0	57.4	7.7	22.4	8.7	3.8
1945[2]	456	100.0	71.9	2.4	9.2	13.6	2.9
1950	716	100.0	65.2	8.5	10.8	9.8	5.7
1951	852	100.0	59.2	11.0	11.3	11.5	7.0
1952	873	100.0	61.3	15.4	9.9	10.4	4.0
1953	909	100.0	58.1	19.2	8.5	9.8	4.4
1954	892	100.0	60.4	16.1	10.0	8.9	4.6
1955	943	100.0	59.4	15.2	10.2	11.4	3.8
1956	1069	100.0	61.0	16.0	10.0	8.7	4.3
1957	1273	100.0	64.0	14.7	7.9	9.3	4.1
1958[3]	1310	100.0	66.1	12.5	7.4	10.1	3.9

[1] Value of crude oil production excluded.

[2] Figures of mineral production from Burma are included during 1935 and that of Pakistan during 1935, 1940 and 1945.

[3] Provisional

Coal, the principal mineral product, constitutes two-thirds of the total value of mineral production. In 1935 it was a little more than one-third. In recent years, there was a considerable rise in the coal production. During the First Plan period the value of coal produced was from 60 to 65 per cent of the total mineral production. Since 1951 the production of ferrous mine-

ral recorded a considerable rise. That was, in fact, due to a higher output of iron and manganese ores both of which also find export market. At the same time, the domestic consumption of iron ore has been steadily rising. In 1935, the larger production of non-ferrous minerals came from Burma which was separated from India subsequently. In post-war years, the non-ferrous mineral production was 8 to 10 per cent of the total value of minerals. The production of non-matallic minerals and building materials was roughly 13 to 15 per cent; but it was, as high as, 20 per cent in 1935.

The partition of the country in 1947 did not much affect India's mineral resources. With the exception of certain deposits of chromite, gypsum, saltpetre, salt and coal, all other minerals came to India's share. Of course, a considerable proportion of crude oil reserves fell to Pakistan's lot.

The value of mineral production in 1945 was nearly two and a half times that of 1935; in 1950 it was 4 times and by 1958 it was, as high as, 7 times. The value of mineral produced in 1958 was roughly 54 per cent higher than that of 1951, of which 1935 production was hardly one-fifth.

The progress made by the industry, particularly, during the First Plan period, was consistent with the general economic and industrial activity in the country. The positive influence of planning on the growth of the industry may be seen from TABLE NO. 2 giving the quantity index of mineral production during the Plan (s) and the pre-Plan period.

Minerals like coal, iron ore, silver, copper ore, ilmenite, chromite, gypsum, china clay, asbestos and apatite registered rising trends in production during the Plan years, whereas manganese ore, magnesite, kyanite, bauxite, fire clay, steatite and feldspar production exhibited better production trends in the pre-plan period. In absolute terms, the output of certain minerals during Plan period recorded a definite rise. Fall in the output of gold and diamonds was, perhaps, due to the nationalisation campaign; while the fall in the output of kyanite and magnesite could be explained by the unsteady foreign demand.

TABLE NO. 2

Quantity index of minerals produced in India

Base: 1951=100

Industry	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Coal	85	86	87	87	92	94	100	105	104	107	110	113	126
Manganese ore	13	37	36	41	50	69	100	113	147	109	123	131	129
Gold	74	58	76	80	73	87	100	112	99	106	93	92	75
Iron ore	62	66	68	62	77	81	100	108	105	115	127	133	140
Silver	97	67	85	88	77	107	100	121	100	1103	1054	719	862
Chromite	186	268	208	135	116	100	100	211	388	272	535	315	470
Copper ore	89	95	87	87	88	97	100	87	65	93	96	105	109
Gypsum	45	43	25	39	69	101	100	202	288	301	339	416	454
Ilmenite	77	87	116	102	138	95	100	100	96	107	111	150	132
Magnesite	24	38	44	41	77	45	100	75	79	60	49	78	76
Kyanite	41	32	34	30	47	84	100	63	36	100	28	47	55
Bauxite	21	15	28	33	63	96	100	95	106	111	121	136	144
China Clay	97	105	96	60	61	78	100	124	137	211	170	250	262
Fire Clay	71	64	87	108	94	110	100	100	74	82	78	123	145
Steatite	67	70	61	54	63	76	100	62	87	126	126	140	131
Barytes	235	277	231	220	210	114	100	95	89	179	72	60	123
Asbestos	158	60	31	15	29	40	100	170	140	75	270	236	329
Feldspar	10	38	50	29	26	53	100	59	115	191	153	97	223
Diamonds	83	66	77	145	97	165	100	123	132	117	107	90	47

Production by States

Geographically, the rich mineral bearing regions of the country are the eastern, the south-eastern, the southern, and the central parts of India, bounded partly by the states of Bihar, Bengal (West), Madhya Pradesh; Bombay, Andhra Pradesh, Madras, Mysore and Rajasthan. Mineral occurrences in states like, Assam the Punjab, Kerala, U.P. and Delhi are relatively less important.

Bihar produces practically all minerals which include coal, iron ore, mica, bauxite, kyanite, limestone, chromite, manganese ore, china clay, fire clay, asbestos, pyrites, apatite, etc. Bihar alone accounts for nearly 75 per cent total coal production in the country, while her mica production is more than two third of the total output in India. In Bengal (West) coal is the chief mineral; other products of minor importance being fire clay, limestone and salt. From Madhya Pradesh, the important minerals are: coal, manganese ore, bauxite, diamonds, iron ore, limestone, china clay, bauxite, salt, etc. Mysore produces mainly gold, manganese ore, iron ore, chromite, china clay, etc. Orissa produces manganese ore, iron ore, chromite, dolomite, china clay, coal, fire clay, limestone, etc. Rajasthan is responsible for gypsum, lead-zinc, limestone, mica, manganese ore and steatite. Assam produces coal and sillimanite. In Kerala, minerals of importance are ilmenite, monazite and china clay. The Punjab yields mainly iron ore, limestone and slate. In U.P., limestone is the main mineral while Delhi has got only china clay.

As a result of States Reorganization in November 1956, some changes took place in the mineral allocations of certain states. TABLE No. 3 gives the mineral production by states, shown as a percentage of the total value during certain years, after and prior to States reorganization.

Generally, more than 50 per cent of country's mineral output comes from the States of Bihar and Bengal (West). Nearly 40 per cent of the total mineral production in India was from Bihar prior to states reorganisation, but, in later years, it came down to about 35 per cent as a result of increased mining activities in other states. Mineral allocations to Bombay, Madhya Pra-

TABLE No. 3

Mineral production in India by States in selected yearss

States	*Prior to Reorganization*		*Reorganized*	
	1948	1951	1956	1957
Bihar	43.87	37.41	35.63	35.55
Bengal (West)	17.89	13.36	17.53	20.59
M.P.	10.57	15.14	12.11	11.31
Bombay	4.01	3.95	8.69	9.67
Mysore	8.15	6.50	7.31	5.87
Orissa	2.82	6.11	5.02	5.50
Andhra	3.50	5.26	5.63	5.20
Madras	3.36	3.74	2.13	1.24
Rajasthan	3.62	5.60	2.72	2.17
Assam	1.14	1.10	1.33	1.28
Kerala	0.30	0.34	0.14	0.17
U.P.	0.46	0.60	0.17	0.19
Total	100.00	100.00	100.00	100.00

desh, Mysore, Andhra Pradesh and Madras were affected by the States reorganisation. Certain manganese ore-bearing regions of Madhya Pradesh were transferred to Bombay, while the mineral resources of Madhya Pradesh were enriched by the merging of Vindhya Pradesh and Madhya Bharat with that. Certain mineral deposits of Hyderabad, Mysore and Madras were allocated to Andhra Pradesh. Saurashtra, on being merged with Bombay, also enriched the mineral resources of that state.

Employment in Mines

The employment offered by the mining industry has an important bearing on the economic activity of the country. The

mineral output is generally dependent on the number of workers employed, as in India the manual labour mostly handle the mining operations. The growth of the mining industry is thus intimately linked with the question of employment. The man-power employed for the exploitation of mineral resources is an insignificant fraction of the total population of the country. Coal, manganese ore, iron ore and mica, the four principle mining industries, absorb nearly 85 per cent of the total workers engaged in the entire mining industry as is evident from TABLE No. 4 given below.

TABLE No. 4.

Workers employed in principal mining industries

(shown as percentage)

Year	*Total*	*Coal*	*Manganese ore*	*Iron ore*	*Mica*	*Others*
1951	100.0	64.1	10.1	3.7	9.5	12.6
1952	100.0	62.3	13.5	4.7	7.3	12.2
1953	100.0	57.4	18.7	5.1	5.9	12.9
1954	100.0	60.0	15.0	5.4	4.8	14.8
1955	100.0	58.9	15.2	5.8	5.2	14.9
1956	100.0	56.0	17.5	6.0	5.4	15.1
1957	100.0	56.9	16.9	6.2	5.4	14.6

An overall increase of 100 per cent took place on the employment side in the entire mining industry from 1951 to 1957. The share of coal and mica industries was relatively less while the manganese ore, iron ore and other industries offered more employment.

From the number of workers employed in different industries, in some of the past years, it may be possible to study the rate of growth of the industry. TABLE No. 5 gives an average number of daily workers employed in some of the important mining industries in certain past years.

A considerable rise in the mine employment took place during the period under review; the coal industry, however, engaged the largest number of workers. Mineral industries producing coal, iron ore, limestone, copper ore, china clay, gypsum, bauxite, asbestos, etc. recorded a definite rise in employment. In industries like manganese ore, mica, magnesite and kyanite wide fluctuations took place in the number of workers employed and that was perhaps, due to the irregular demand for some of those minerals from foreign quarters.

Mining Units

The growth of the mining industry in India in the past has been marked by the increase in mineral output accompanied by the rise in number of workers employed. At the same time, the number of units in the industry registered a considerable increase. In a period of about 20 years or so, the number of mining units had gone up by nearly 50 per cent. TABLE No. 6 gives the number of mining units in some of the important industries in certain past years.

Coal, manganese ore and mica, the three pricipal mining industries account for more than 80 per cent of the total number of mining units in the country. Nearly 10 per cent of the units are for mining iron ore, limestone and building stone; the rest 10 per cent are engaged in raising other minerals. The rise in the manganese and iron ore mines was phenomenal in the post-independence period.

From the number of daily workers employed during different years, it may be possible to roughly assess the extent of expansion that took place in some of the industries. TABLE No. 7 gives the number of per unit power employed in some of the industries during 1945, 1950, and 1955.

TABLE NO

Average number of daily workers employed

Industry	1938	1939	1944	1945	1946	1947	1948
Coal	226887	231463	285428	334445	367233	363994	348383
Manganese Ore	35548	31026	17205	9986	12930	19708	20171
Mica	31066	33601	47858	45022	38791	32655	32527
Iron Ore	19577	19950	17394	15571	16474	15368	9530
Salt	57665	53606	69684	64680	60789	61614	39440
Gold	24200	24528	17869	16793	18316	19714	24579
Limestone	12071	7239	9265	10118	11217	10954	12406
Building Stone	11553	13737	10799	9071	7072	7526	6397
Copper Ore	2737	3092	4030	3373	3757	3961	3636
China clay	1322	1862	3848	3483	3694	2527	2430
Fire clay	940	875	939	1092	938	995	1127
Magnesite	1686	2934	2381	910	2595	2383	2827
Chromite	1958	1807	1926	1834	2026	1483	1405
Gypsum	295	484	781	1055	723	1084	1405
Ilmenite	*	*	*	*	1993	1278	1020
Kyanite	161	23	*	*	*	*	289
Diamonds	1005	706	1177	879	764	845	2150
Petroleum	7655	6351	7305	6456	4304	3467	3404
Bauxite	109	85	1241	218	83	104	534
Steatite	292	426	651	1031	509	475	389
Slate	552	604	360	357	378	425	473
Barytes	92	103	98	443	445	299	364
Asbestos	4	258	227	314	*	*	*
Feldspar	18	23	45	51	67	127	41
Graphite	7	11	122	141	135	143	115

* Not available.

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in different types of mines in selected years

1949	1950	1951	1952	1953	1954	1955	1956
345190	350204	352095	348738	341243	340964	347980	352429
23129	36580	56682	82588	118069	84821	89907	109948
30106	35981	53536	41144	34942	27335	30632	33972
17027	18053	21007	26929	36225	30772	34218	37301
60541	59990	59183	41966	34946	45591	38296	*
24621	24747	21939	20349	22934	18054	17787	17890
12903	15304	15980	14466	17548	25753	27653	30701
504	4516	5108	3868	4114	5462	4932	5886
3605	3655	3710	3880	3685	4052	4114	4070
2649	2764	3662	3608	4129	3570	3854	5802
1247	1267	1071	1144	706	963	1117	1307
3754	2446	3544	3720	3795	3181	2777	4223
1651	1769	1543	2112	2158	1341	1981	2237
1781	1138	1599	2736	3031	3118	4227	4249
1527	1416	1951	2627	2950	2807	3083	2418
432	939	1332	2164	2418	1804	2640	2485
1025	2963	1934	1553	2201	1958	1840	911
3366	3468	3421	3471	3614	3354	3183	3147
572	1537	1010	1259	888	1511	926	1154
641	511	1409	1277	1302	1424	1637	1999
656	618	616	529	507	588	549	452
*	293	491	241	191	697	449	921
314	406	561	808	897	1064	1815	1529
52	24	121	93	126	214	147	201
185	202	163	214	214	249	358	363

TABLE No 6

Number of units in Mining Industries in India in selected years

Industry	1938	1939	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
Total No	1953	1864	2359	2151	2119	1977	1897	2051	2003	2703	2603	2757	2873	2854	3106
Coal	665	619	910	973	960	902	897	908	891	893	860	858	853	853	843
Manganese ore	126	113	77	65	103	108	117	160	184	234	333	504	503	556	680
Mica	839	812	1009	784	737	740	665	702	750	1160	1010	941	881	810	849
Iron ore	8	9	6	4	5	4	4	18	22	34	56	76	108	123	140
Lime Stone	37	30	43	45	46	46	44	34	46	50	49	67	82	87	99
Building stone	123	118	90	71	66	60	57	56	46	57	50	54	80	61	84
Copper ore	5	6	7	6	4	4	4	4	4	4	4	4	4	3	4
China Clay	16	15	25	25	26	20	19	20	20	37	38	38	31	28	58
Fire Clay	17	16	11	11	9	13	17	18	20	18	17	12	23	28	32
Magnesite	3	3	3	2	4	4	4	4	4	7	7	8	9	6	8
Chromite	52	51	83	77	82	11	8	11	9	17	18	16	17	13	15
Gypsum	2	5	6	8	8	6	8	10	7	10	11	13	18	22	21
Kyanite	1	2	—	—	1	—	3	4	4	14	16	15	12	14	16
Steatite	19	23	19	13	11	10	10	15	15	28	29	32	31	33	34
Bauxite	3	3	5	5	4	5	7	8	8	11	10	10	13	12	16
Asbestos	1	1	3	5	—	—	—	7	10	19	19	19	29	33	34
Barytes	3	3	3	7	7	6	7	10	7	9	5	5	10	9	12
Graphite	1	2	3	4	4	5	4	3	8	8	9	7	9	9	11
Slate	14	14	19	20	16	14	15	23	19	19	15	15	19	20	19
Feldspar	2	3	6	7	5	8	3	4	2	7	6	8	13	9	11

TABLE No 7

Average number of workers employed per unit in selected years

Industry	1945		1950		1955	
	Unit No.	*Per unit workers No.*	*Unit No.*	*Per unit workers No.*	*Unit No.*	*Per unit workers No.*
Coal	973	303	891	393	853	408
Manganese ore	65	147	184	192	556	162
Mica	784	49	750	48	810	38
Iron ore	4	1721	22	821	123	278
Limestone	45	225	46	333	87	318
Building stone	71	127	46	98	61	81
Copper ore	6	562	4	914	3	1357
China Clay	25	139	20	138	28	166
Fire clay	11	99	20	54	28	39
Magnesite	2	455	4	886	6	704
Chromite	77	23	9	196	13	172
Gypsum	8	132	7	163	22	192
Steatite	13	79	15	34	33	50
Bauxite	5	44	8	192	12	77
Kyanite	—	—	4	235	14	189
Asbestos	5	63	10	41	33	55
Barytes	7	63	7	42	9	84

With the exception of coal, copper ore and chromite, the number of units in all mining industries had gone up. In about ten years the number of workers employed per unit in some of the industries recorded a considerable rise. The increase per unit in the case of copper ore and magnesite was substantial. In industries like mica, building stone, fire clay, steatite, asbestos and barytes, the rise in number of units was accompanied by a fall in per unit employment. With the exception of few products, the growth of the mining industry was generally steady and uninterrupted.

Limitations

Production activity in the mining industry is dependent on several factors. The actual mining operations are governed by a number of limitations. As a matter of fact, the natural resources, on which the production planning rests, are always limited and are liable to depletion at one time or the other. In a way, these are never infinite and inexhaustible. There is always a time factor acting as a gap between the planning and the production. In certain cases, the time involved in materializing production efforts extends even to years. With the inequitable regional distributon of resources the economics of production at different points is likely to be varying considerably. Thus, the development of the mining industry in the country has to be considered in the context of the various limiting factors.

The occurrence of a specific mineralogical deposit at a particular place is a nature's endowment and that has to be acknowledged with a clear understanding. Even though some of the mineral reserves are inexhaustible, the question of planned exploitation and conservation of resources is of primary importance. The nature of deposits and their geological structure further regulate the production schedule. The technological considerations also determine the progress of the production operations. The various differentials that account for production planning in the mining industry are, thus, the nature of deposits, the quality and the quantity of reserves, the working conditions, the available transport facilities, and the proximity to the points of mineral consumption. A significant shift in the consuming areas and the marketing centres equally influence the growth of the industry.

In India, the growth and development of mining industry in the past was influenced by the two main considerations, viz, the pattern of development of mineral consumer industries within the country and the expanding foreign market for minerals. For instance, as fuel coal is indispensable to all industries and provides a base for almost all industrial projects in the country, the rising demand for fuels has led to the increased coal mining

activity. Similarly, India has vast deposits of iron ore to feed her expanding iron and steel industry and a fair proportion of that is also being exported. With the expansion of indigenous steel production and with expanding foreign market, the demand for iron ore is moving up rapidly. In the supply of mica and ilmenite to the world market India holds a monopoly. India's position is particularly dynamic in her capacity to export manganese ore. Country's deposits of bauxite, magnesite and limestone are equally vast. India is, perhaps, at a disadvantage in the supply of non-ferrous metals, sulphur, petroleum and certain other minerals of which her domestic resources are poor.

Based on availability and their utility, important minerals can be broadly grouped. For example, minerals like iron ore, mica, manganese ore, bauxite, kyanite, ilmenite and magnesite are found plentiful, of which a fair propotrion is available for export purposes and can be placed in one category. Minerals like limestone, marble, slate, sodium salts, feldspar, barytes, etc. are just sufficient for India's domestic consumption and can be placed in the other category. To another category belong the minerals which are in scarce supply, viz., petroleum, sulphur, lead, zinc, tin, nickel, mercury, etc. Apart from minerals mentioned above India has fair deposits of certain rare and radio-active minerals. The type of classification indicated above is not a conclusive one, as with fresh explorations and new prospecting work, a mineral scarce today can be a surplus tomorrow. To avoid any such confusion, the minerals surveyed in the following chapter are arranged in alphabetical order.

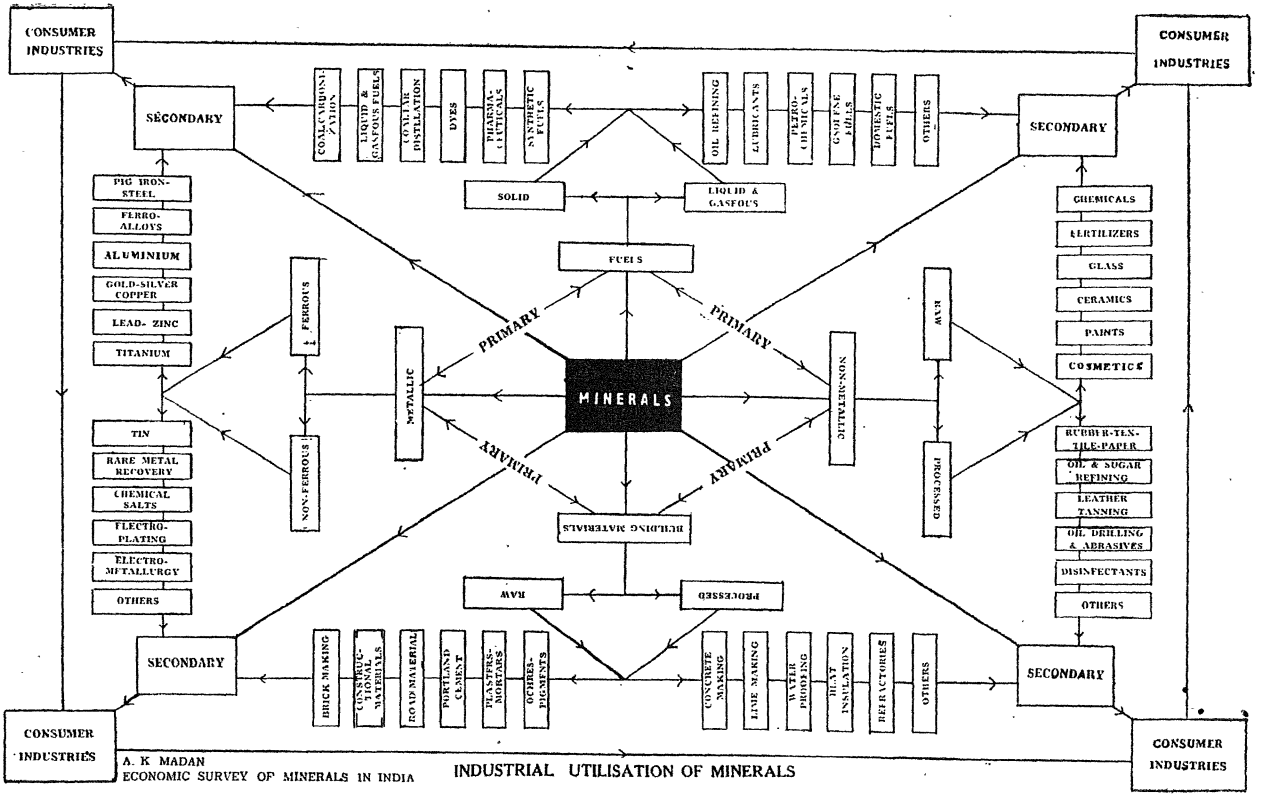
CHAPTER III

SURVEY OF MINERALS AND MINERAL PRODUCTS

In recent years the mining development programme, including the exploration, extraction, processing, refining and marketing of minerals, has assumed a great importance all over the world. Due emphasis is being laid on the application of the right technique of production, the programme of a balanced supply and on the conservational aspect of minerals. Efforts are being made to attain the highest standard in mineral productivity and to achieve the maximum efficiency in mining. Wise and efficient use of mineral resources mostly depends on the extent of advances made in the sphere of technology. The expansion programme, in the field of mining, has posed not only the technological problems but has also raised certain economic issues. With growing mining industry in India, the question of planned production and utilization of minerals has become quite pertinent.

Minerals and mineral products hold a unique position in the country's economy. Through mining, it is possible to obtain ores and metals which are the starting point of various capital and consumer industries. Minerals are the basic raw materials needed by all types of industries. Each and every industry owes its existence to one mineral or the other. For some industries minerals provide a major base while the working of others is aided by minerals. The importance of minerals is well illustrated from the chart given over leaf, depicting their utilization aspect.

In examining the economic potentialities of the mining industry, the appraisal of the available resources and the estimation of mineral reserves are the primary considerations. For an elaborate survey, the scope of the study should be extended to the examination of other important aspects, like the nature and geographic distribution of mineral deposits, the size of mining organization, the technology of production, the problem of



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marketing, the price structure, the tariffs and taxes and the pattern of mineral consumption, but, to make it more pointed, its field has been limited to reviewing the mineral-wise production trends and the utilization aspect.

ABRASIVES

Natural abrasives include a wide variety of rocks and minerals. The natural high grade abrasives are: diamonds, corundum (including emery and impure corundum) and garnet, while the cheap siliceous abrasives include grinding stones, millstones, grinding pebbles, silica, rubbing and polishing powders, etc.

Production

In India, deposits of natural high grade and siliceous abrasives are known to occur in some of the places give nbelow:

Natural High Grade

		Important occurrences
1. Diamonds	Andhra Pradesh:	Cuddapah, Anantapur, Krishna, Guntur, Godavari, Kurnool districts.
	Madhya Pradesh:	(Vindhyan rocks of Central India) Panna, Charkhari, Ajaigarh and Bijawar.
2. Corundum	Assam:	Khasi Hills.
	Bihar:	Hazaribagh and Singhbhum districts.
	Madras:	Palakod and Paparapatti in Salem district, Tiruchirapalli and Coimbatore.
	Mysore:	Kolar, Tumkur, Hasan, Kadur, Bangalore and Mysore districts.
	Kashmir:	Corundum with sapphires occurs in Udhampur district.
	Madhya Pradesh:	Pipra near Rewa State.
3. Garnet	Bihar:	Hazaribagh and Singhbhum districts.

	Orissa:	Mahanadi valley around Cuttack.
	Andhra Pradesh:	Nellore, Krishna and Vijayawada districts.
	Mysore: & Rajasthan:	Several places.
4. Emery	No definite deposits.	

Natural Siliceous

1. Flint	Bihar, Orissa, Madhya Pradesh, Bombay, Madras & U.P. :	Several places.
2. Quartz	Bihar:	Singhbhum and Hazaribagh.
	Andhra Pradesh:	Nellore.
	Rajasthan:	Ajmer-Merwara and Kishangarh.
3. Sand Stone	Bihar:	Patharghatta, Bhagalpur dist.
	Rajasthan:	Jaipur and Sawai Madhopur.
	Punjab:	Jaijon, Hoshiarpur district.
	U.P. :	Dehra Dun; Loghra and Bograh near Naini, Allahabad.
	Kashmir:	Certain places.
4. Talc	Rajasthan:	Jaipur and Jodhpur.

Some of the abrasives mentioned above are described under specific minerals in subsequent pages. Diamonds produced in the country are the precious variety and are dealt with separately in this chapter. Practically there is no production of industrial diamonds in India. The total world output industrial diamonds in 1957 was a little over 20 million carats, the production mainly comes from French Equitorial Africa, the Union of South Africa, Ghana and Sierra Leone.

In India, the corundum production mainly comes from the Sidhi District of Madhya Prades hand Hassan district of Mysore, and also a minor production comes from Madras. TABLE No. 8 below gives the production of corundum in India from 1945 onward.

TABLE No. 8

Production of Corundum in India

Year	*Quantity* Tons (000)	*Value* Rs. (000)
1945	0.40	186
1946	0.10	27
1947	0.18	49
1948	0.28	31
1949	0.19	42
1950	0.30	139
1951	0.55	229
1952	0.64	257
1953	0.32	96
1954	4.70	168
1955	0.24	63
1956	0.35	198
1957	0.44	246
1958	0.39	189

There was a steady rise in production from 1946 to 1952. After an abnormal output in 1954, the industry received a set back. A steep fall in output took place in subsequent years. The per ton value of corundum had gone up by nearly 100 per cent in about 12 years. The slow progress made by the corundum industry in the past could be explained by the unhealthy competition it faced from synthetic abrasives and due to the irregular demand for the natural products.

The total world output of corundum in 1956 was a little over 10 thousand tons; the production mainly comes from the Union of South Africa, Rhodesia and Nyasaland.

Cheap and common variety of abrasives like feldspar, limestone, pumice, pebbles, tripoli, rottenstone and granite are found in abundance in the country.

Utilization

Diamonds are the hardest variety of abrasives. Diamond drills are extensively used in the petroleum drilling industry. Cutting tools and wire drawing dies are also produced from diamond bits. Diamond dust is also used for polishing and

grinding hard surfaces. Corundum powder is a hard type of abrasive and is used as such or bonded into a grinding wheel. Emery and garnet powders are also coated on paper or cloth and are used for rubbing surfaces of metal, leather and hardwood.

Abrasives find extensive use in industries like metalware, electroplating, automobile, surgical instruments, hospital equipment, presentation articles and novelties, where surface polishing is involved, and that is done with the help of certain specially prepared compositions. Abrasives serve a wide range of industries and are used mainly as a medium for cutting, drilling, and polishing external surfaces of materials made of metal, wood, leather, rubber and plastics. The polishing of building stones and tiles is done with the help of abrasives. In glass industry, the cutting, grinding and polishing is done with abrasives. Appliances and accessories, such as the polishing liquids, polishing powders, sand paper or cloth, emery paper or cloth are largely used in a number of industries.

While natural abrasives are quite popular, the artificial abrasives like the silicon carbide (carborundum), boron carbide and fused alumina (alundum) being superior in hardness are at present gaining more importance in the industry. There are, nearly a dozen grinding wheel and coated abrasives manufacturers in the country. Synthetic abrasive grains and binding materials are the principal raw materials used in the manufacture of grinding wheels. At present, the grinding wheel industry enjoys a tariff protection, as some of the raw materials needed for the industry are imported from abroad. Coated abrasives on paper or cloth in sheets rolls, discs, belts, tapes, or coils are produced from natural abrasive minerals, such as quartz, garnet, corundum and emery.

There is a considerable demand for some of the coated abrasives in the country. No reliable data about consumption of abrasive materials is available. Provisions have been made in the Second Five-Year Plan to produce within the country, some of the raw materials needed by the industry. India is a growing market for abrasives. Prospects for developing this industry on a commercial scale are fairly bright, as minerals

needed for that purpose are plentifully available in the country. Lack of grading and standarization facilities for raw materials is perhaps, the real handicap in the development of the natural abrasive industry in the country. With a keen competition from synthetic abrasives, the question of using natural abrasives has to be considered carefully. The indigenous abrasive industry needs a definite encouragement. There is also a scope for finding an export market for the Indian abrasive materials after the industry is organized on a scientific footing.

ANTIMONY

Antimony occurs in nature as sulphide and as oxide both in simple and complex forms. The usual sulphide ore known as "Stibinite" is found intimately mixed with quartz. Metal contents of different ores vary widely depending on their chemical composition.

'Stibinite' is found in small deposits in the Shigree galcier in Lahaul in Kangra district (Punjab). A small production of antimony ore was reported from Chikkannanahalli in the Chitaldroog district of Mysore during the first world war. Minor occurrences of ore are also known in the Hazaribagh district (Bihar), Hyderabad, Bellary and Cuddapah districts of Andhra Pradesh and Jabalpur district of Madhya Pradesh. Recently, deposits of antimony ore have also been reported from Kolari Village (Umret Tehsil) in Nagpur district. So far the prospecting of those deposits has not been done.

The main antimony ore producing countries of the world are: the Union of South Africa, Bolivia, Mexico, Czechoslovakia, China, Yugoslavia, Algeria, Austria and Peru. Other ore producing countries are Canada, Japan, Italy and France. TABLE No. 87 in the appendix gives the output of antimoney ore of a few selected countries from 1947 to 1957. Presently, the world production of the antimony ore is of the order of 50 thousand tons per annum..

Utilization

As metal antimony has limited applications, but, in the form of alloys, it finds numerous uses. Alloyed with copper and tin,

antimony is extensively used as type metal, antifriction bearing metal and as britannia metal. Antimonial lead finds use in the sharpened bullets and is also used in the grids of electrical storage batteries. Certain compounds of antimony are used in match manufacture. Antimony salts are also used as mordants in textile industry As oxide, it is used in enamel works. Sulphides of antimony, in different shades, ranging from golden to crimson, are much recommended for use in the rubber industry as colouring pigments and as vulcanizing agents.

In India a metal refinery for extracting antimony was set up in Bombay as early as 1941. The ore supply originally being obtained from Chitral (now in Pakistan) was cut off after the partition of the country in 1947. After that the ore is being obtained from other sources, such as Bolivia, Peru, Iran, Turkey and China.

The Bombay refinery has an installed capacity of about 1000 tons of metal and that is sufficient to satisfy country's requirements of antimony metal. TABLE No 9 gives the past production of antimony metal from 1941 onwards.

TABLE No. 9

Production of Antimony in India

Year	*Tons*	*Year*	*Tons*
1941	56	1950	376
1942	156	1951	328
1943	130	1952	181
1944	105	1953	130
1945	157	1954	539
1946	132	1955	504
1947	235	1956	589
1948	330	1957	502
1949	100	1958	527

The antimony industry got traiff protection in 1947. Since then it has been enjoying a varying degree of protection. The consumption of antimony during 1958 was 600 tons, while the estimated annual demand for the metal during 1960-61 is likely to be about 700 to 800 tons.

The problem of procurement of raw material from foreign sources is very acute. Even for the various antimoney compounds the country has to depend upon foreign countries, like the U.K., Germany West, Belgium, China, Bolivia, Turkey, and the U.S.A. In 1958 India imported nearly 44 tons of antimony oxide valued at more than a lakh of rupees and about 3 tons of antimony sulphide worth Rs. 10 thousand from the above mentioned sources, as against 100 tons (value: Rs. 2.5 lakhs) of antimony oxide and 353 tons (value: Rs. 4.6 lakhs) antimony sulphide in 1957. As antimony industry is of strategic importance, the question of exploiting country's own deposits is really quite pertinent. There is, in fact, an urgent need to undertake the prospecting of known deposits of antimony ore in the country.

ARSENIC

Arsenic occurs in nature as "arsenopyrite," the sulpharesenide of iron containing more than 45 per cent arsenic. Other sulphides of arsenic are "lollingite" and "leucropyrite." In commerce, the term "arsenic" or "white arsenic" is used for the trioxide, instead of elementary or metallic arsenic.

Arsenopyrite is located in Sampthar Hill in the Kalimpong area of Darjeeling district; the arsenic contents of that having been assayed above 25 per cent. Arsenic is also known to occur near Barali in the Bhutna valley of Kashmir. A minor occurrence of orpiment, the yellow sulphide of arsenic, near Munsiari in Kumaon was also reported in some earlier years. In the pre-partition days, the arsenic deposits of Chitral (now in Pakistan) were understood to be of some commercial value. In Hazaribagh district of Bihar, the mica-bearing pegmatites are also known to contain certain quantity of arsenide Most of these known deposits are of little commercial value.

World production of arsenic mainly comes from countries like the U.S.A., Sweden, Mexico, Belgium, France, Italy, Portugal, Peru, Japan and Germany. Production in smaller quantity also comes from Canada, Argentina, Brazil, Spain, Southern Rhodesia, Australia and other countries. TABLE No. 88 in the

appendix gives the production of white arsenic of certain selected countries of the world from 1947 to 1957.

Utilization

Arsenic, the steel grey brittle bright lustrous metal, has a little direct use, but it finds application in the production of certain alloys of copper and lead. As oxide, it is used in glass and enamel manufacture but as sulphide it has minor uses. Being extremely poisonous, the oxide is also used as a rat poison and as a constituent of weed killers and in preparations for the extermination of white ants. In medical science certain dozes of arsenic oxide are recommended for the treatment of syphilis, malaria, leukaema, etc. Organic compounds of arsenic are also administered in certain diseases. Orpiment, the yellow sulphide of arsenic, is used as pigment in the manufacture of ornamental lac ware and lacquer work.

India's requirements in white arsenic including the trioxide and pentoxide of arsenic are satisfied through imports from foreign sources, like the U.K., Sweden, Germany (West), Hongkong, China and the U.S.A. About 200 to 300 tons of white arsenic are annually consumed in India, of which nearly 60 per cent is utilized by the glass industry. TABLE No. 10 below gives

TABLE No. 10

Quantity and value of Arsenic white imported into India

Year	*Quantity* Tons	*Value* Rs. (000)	*Year*	*Quantity* Tons	*Value* Rs. (000)
1935-36	146	80	1947-48	820	795
1936-37	203	99	1948-49	117	143
1937-38	267	117	1949-50	42	69
1938-39	281	118	1950-51	63	78
1939-40	243	107	1951-52	198	344
1940-41	276	128	1952-53	99	178
1941-42	299	117	1953-54	283	345
1942-43	1	1	1954-55	354	335
1943-44	20	4	1955-56	510	374
1944-45	27	14	1956-57	363	267
1945-46	102	53	1957-58	525	341
1946-47	253	44	1958-59	112	74

the quantity and value of past imports of white arsenic into India since 1935-36. Apart from that the country also imports annually certain quantity of arsenic, arsenic sulphide and other arsenic compounds.

Wide fluctuations in past imports of arsenic were due to the irregular demand for the product and the frequent changes enforced in the import quotas. The price of arsenic registered a considerable rise in war years.

India's resources of arsenic are very poor. Unless, the prospecting and assessment of country's known deposits of arsenic is taken up in hand India will have to continue depending on foreign supplies of arsenic and its compounds for a considerable time to come.

ASBESTOS

In nature asbestos occurs, as hydrated magnesium silicate known as "chrysotile". As calcium magnesium silicate it is known as 'amphibole". Tremolite, actinolite and anthophyllite have also got a similar composition and belong to the amphibole variety.

Production

Asbestos (amphibole) occurs in small quantities in Hassan district of Mysore, Udaipur and Bhilwara districts of Rajasthan, Seraikela, Singhbum districts of Biahr. Asbestos (chrysotile) suitabel for weaving purposes is available in Anantapur and Cuddapah district (Pulivendla taluk) of Andhra Pradesh. Occurrences at Brahamanapalli and Chinnakudale are of considerable importance. A small production of asbestos also comes from Madhya Pradesh and Bombay. TABLE No. 11 gives the production of asbestos in India from 1935 onwards.

In pre-war years, the industry operated on a modest scale. During war years the production was stepped up as foreign supplies of asbestos products were restricted. From 1951 the industry started showing definite production trends. The per ton value of asbestos produced showed considerable fluctuations in different years. That was, perhaps, due to the uneven quality of the mineral produced.

TABLE NO. 11

Production Of Asbestos In India

Year	Quantity	Value	
	Tons (000)	Total Rs. (000)	Average Per Ton Rs.
1935	0.06	4.6	77
1936	0.36	3.1	52
1937	0.10	6.0	60
1938	0.09	4.5	50
1939	0.26	41.9	160
1940	0.29	41.8	144
1941	0.37	39.3	122
1942	0.51	116.8	229
1943	0.89	69.0	77
1944	0.58	121.8	210
1945	0.82	78.4	991
1946	0.31	41.0	156
1947	0.16	15.4	96
1948	0.08	98.4	110
1949	0.15	89.8	599
1950	0.21	180.8	860
1951	0.51	238.8	460
1952	0.87	493.4	567
1953	0.72	555.0	767
1954	0.39	229.0	587
1955	1.40	649.0	470
1956	1.23	411.0	334
1957	1.71	423.0	247
1958	1.06	312.0	294

World's main sources of asbestos are Canada, the Union of South Africa, the U.S.S.R., South Rhodesia, Cyprus, the U.S.A., Italy, Finland and Czechoslovakia. Nearly 70 per cent of the total world output comes from Canada. TABLE No 89 in the appendix gives the output of asbestos from certain selected countries of the world from 1947 to 1957.

Utilization

On account of its high insulating properties, asbestos is used for manufacturing heat resisting compounds like the asbestos magnesia and asbestos hard setting compositions which are

commonly employed for lagging boilers and steam pipes. Long staple asbestos fibres, mixed with portland cement, are used in the manufacture of corrugated sheets and shingles which find extensive use in the building industry. Asbestos textiles, yarn, cordage and cloth in the form of compressed sheets find numerous uses in different industries. Asbestos is also used in the manufacture of paints and fire proofing cements. Asbestos is an ideal filtering medium for fruit juices and acids. As jointing material, asbestos is a product of great commercial use in engineering industries.

TABLE No 12

Imports Of Asbestos Raw & Manufactured

Year	*Raw*		*Manufactured*
	Tons	Rs. Lakhs	Rs. Lakhs.
1935-56	1015	2.04	12.11
1936-37	1264	1.98	13.38
1937-38	2642	4.15	13.41
1938-39	3658	7.32	13.56
1939-40	2503	6.43	13.92
1940-41	7525	20.71	17.57
1941-42	8150	26.95	28.94
1942-43	11328	43.24	19.81
1943-44	6394	31.20	11.53
1944-45	10555	43.66	19.84
1945-46	4895	26.76	25.29
1946-47	7612	32.56	25.63
1947-48	4036	19.90	33.09
1948-49	8685	54.84	46.73
1949-50	6985	53.45	57.89
1950-51	12070	106.76	49.30
1951-52	10970	115.88	56.35
1952-53	8569	113.70	52.51
1953-54	4160	52.26	54.73
1954-55	9016	120.11	56.86
1955-56	13001	154.99	79.34
1956-57	17449	82.27	98.81
1957-58	16223	236.14	56.81
1958-59	16337	214.84	43.89

India is not self-sufficient in her requirements of asbestos products. For domestic consumption, the country imports both

raw and manufactured asbestos goods in a fair quantity; the raw asbestos mainly comes from Swaziland, Rhodesia Northern and Southern, Kenya, Nysaland, Mozambique and Canada and the manufactured products are obtained from the U.K., Germany west, Italy, Japan, Canada and the U.S.A. In small quantity, the Indian crude asbestos has also now started finding export market. At present, the material is being sent to Japan, Italy, Belgium, Pakistan and certain other countries. TABLE No. 12 gives the quantity and value of asbetsos raw and manufactured imported into India since 1935-36.

The Indian asbestos is generally of short fibre length and is, therefore, inferior. There is an urgent need to find out substitute of asbestos, as country's own resources for this commodity are limited. At the same time, the question of undertaking further exploratory work connected with the prospecting and geological surveys demands an immediate attention.

BARIUM MINERALS

Barytes and whitherite are the two common barium minerals found in nature. Barytes also known as 'heavy spars' is chemically the sulphate of barium, while whitherite is the natural barium carbonate. The shade and colour of barytes vary from deposit to deposit, ranging from off-colour grey shade to snow white.

Production

In India, the barytes deposits are known mainly in the Cuddapah, Anantapur and Kurnool districts of Andhra Pradesh. The mineral deposits which require a specific mention are, at Nerijamupalle and Mutssukota in the Tadpatri taluk of Anantapur ditsrict, at Kottapalle in the Pulivendla taluk of Cuddapah district and the Balapalapalle west of Betamcherla and at Hussainpuram, Ramapuram, Valasala, Rahimanpuram and Gattimanikonda in the Dhone taluk. Rapasthan has also certain deposits of barytes. The Alwar deposits of Rajasthan are mainly located at Sainpuri, Bhakhera and Rampur. Minor barytes deposits are also located in Madhya Pradesh and Bihar. India has prctically no whitherite deposits.

The largest production of barytes comes from Andhra Pradesh. TABLE No. 13, below gives the quantity and value of barytes produced in India from 1935 onwards.

TABLE No. 13

Production Of Barytes In India

	Quantity	*Value*	
Year	Tons (000)	Total Rs. Lakhs.	Average Per ton Rs.
1935	5.5	0.35	6.36
1936	5.1	0.16	3.14
1937	15.7	1.49	9.68
1938	8.1	0.29	3.58
1939	9.2	0.61	6.63
1940	18.8	1.43	7.61
1941	23.5	1.14	4.84
1942	11.2	0.19	8.82
1943	8.9	1.16	13.03
1944	15.3	1.79	11.05
1945	24.7	4.27	17.13
1946	29.1	3.69	12.68
1947	24.3	3.30	13.58
1948	23.1	3.60	15.58
1949	21.1	2.91	13.79
1950	12.0	2.42	20.70
1951	10.5	3.11	29.61
1952	10.0	3.07	30.70
1953	9.4	1.25	13.30
1954	18.8	2.61	13.88
1955	7.62	1.34	17.63
1956	6.32	1.07	16.93
1957	12.91	2.67	20.68
1958	13.82	2.74	19.83

The output of the industry was generally irregular in the past. In war years, the output of barytes was higher. After reaching the peak production in 1946, the production declined. The production of barytes was unsteady even during the First-Plan period. Irregular demand for the mineral was generally responsible for the wide fluctuations in production. The per-ton

value of the mineral was varying in different years. The industry appears to be operating under uncertain conditions.

World's main producers of barytes are: the U.S.A., Germany West, Canada, Mexico, Italy, the U.S.S.R. and the U.K. Production, in small quantity, comes from Yugoslavia, Peru, France, Algeria, Japan and other countries. Of the estimated world production 3 million tons of barytes in 1957, nearly 40 per cent came from the U.S.A., and 13 per cent from Germany West. TABLE No. 90, in the appendix, gives the output of barytes from a few selected countries of the world from 1947 to 1957.

Utilization

Barytes finds vast applications in the paint industry. It also forms nearly 70 per cent of the chemical contents of lithopone, a product largely used in paint and rubber industries. Off-colour barytes of fine mesh, is used in bulk quantity in the oil drilling operations. Barytes is also used, as a filler, in the manufacture of rubber tyres and other rubber goods, paper cloth and linoleum. In minor quantity it is used in the production of certain types of glass, enamels and glazes. Barytes is an important raw material for the manufacture of the chemical compounds of barium, such as the sulphide, the carbonate, the chloride and the nitrate. Barium alloyed with nickel is used in ingnition equipment in the automobile industry. Barium-nickel alloys also find extensive use in the radio industry.

TABLE No 14

Quantity and value of Barytes Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1951-52	5.09	5.49
1952-53	2.35	2.69
1953-54	5.50	5.69
1954-55	5.44	5.80
1955-56	2.62	9.95
1956-57	10.08	10.76
1957-58	18.29	22.69
1958-59	17.74	21.44

Apart from the domestic consumption of barytes, quite a fair proportion of indigenous production is annually exported to countries, like Pakistan, Burma, Malaya, Iraq, Tanganyika and Japan. TABLE No. 14 gives the quantity and value of barytes exported out of India, since 1951-52. In recent years, particularly during the Second-Plan period, there was a considerable improvement in the export of barytes.

Finer quality of barytes needed by the paint industry is imported mainly from the U.K. and Germany West. Lithopone the principal barium pigment is also in great demand in the country and is also imported from the U.K., Germany West, Belgium, Netherlands and other countries. TABLE No 15 below

TABLE No 15

Quantity and Value of Barytes and Lithopone Imported into India

Year	*Barytes*		*Lithopone*	
	Tons	Rs. (000)	Tons	Rs. (000)
1935-36	673	36.6	1408	314.8
1936-37	372	24.1	1521	279.2
1937-38	465	38.4	1861	348.6
1938-39	452	35.7	1584	294.1
1939-40	107	7.4	2331	538.5
1940-41	29	7.4	1123	377.4
1941-42	51	12.2	1804	780.6
1942-43	18	4.6	1600	755.7
1943-44	38	9.8	1484	722.7
1944-45	3	1.4	1503	665.1
1945-46	2	8.4	975	433.6
1946-47	46	19.2	695	304.1
1947-48	46	19.2	656	565.6
1948-49	11	1.8	1912	1658.4
1949-50	—	—	868	520.3
1950-51	21	12.6	1860	1191.1
1951-52	91	42.4	3019	4205.0
1952-53	53	27.8	1496	1153.4
1953-54	40	18.6	1267	774.5
1954-55	31	18.3	893	618.8
1955-56	76	32.4	641	438.4
1956-57	41	19.9	351	247.5
1957-58	67	27.5	276	218.9
1958-59	56	28.7	113	87.9

gives the quantity and value of barytes and lithopone imported during the past 24 years.

Favourable condition exist in the country to undertake the manufature of lithopone and other pigments. Salts of barium like that of carbonate, chloride, sulphide and nitrate, etc. which are at present, imported from abroad can also be manufactured in the country. India has sufficient reserves of barytes to meet her domestic requirements. Further, exploratory work can help to locate more reserves of barytes.

BAUXITE

Bauxite, the hydrated oxide of aluminium, is the prinicpal ore of metal aluminium. It is normally described as aluminous laterite, a ferruginous type of rock.

Production

Bauxite is found near Katni in the Jabalpur district of Madhya Pradesh and in Belgaum, Thana, Kaira and Kohlapur districts of Bombay. Bauxite deposits in Ranchi and Singhbhum districts of Bihar are fairly large. In Madhya Pradesh, other deposits of commercial importance are also located in Bilaspur, Mandla, Surguja, Jashpur State. The States of Kashmir, Madras, Orissa and Mysore are also reported to have fairly good deposits of bauxite. TABLE No. 16 gives the production of bauxite in India from 1935 onwards.

The bauxite production was unsteady in pre-war years, its output was, however, stepped up during war. The industry started showing regular rising trends only in the post-independence period. The bauxite output in 1958 was nearly six and half times the production of 1947. Compared to pre-war years, the pit-head value of bauxite, had also gone up by five to six times.

The principal bauxite producing countries of the world are the British Guinea, the U.S.A., Surinam, Jamaica, France, Hungary, Yugoslavia, the U.S.S.R., Greece, French West Africa, Indonesia, Malaya, Italy and Ghana. Bauxite production also comes from other countries, like Brazil, Austria, Germany, Spain, Australia and Mozambique. TABLE No. 91, in the appendix

TABLE No. 16

Production of Bauxite in India

Year	Quantity	Value	
	Tons (000)	Total Rs. (000)	Average Per ton Rs.
1935	7.6	15	1.97
1936	3.6	7	1.94
1937	15.2	62	4.08
1938	14.8	26	1.76
1940	8.0	17	1.89
1939	9.0	14	1.75
1941	13.0	23	1.77
1942	18.3	42	2.30
1943	24.2	102	4.50
1944	12.8	57	4.71
1945	13.9	131	9.43
1946	9.9	86	8.70
1947	18.5	148	7.98
1948	22.2	176	7.92
1949	42.5	567	13.34
1950	64.4	783	12.16
1951	67.0	752	11.20
1952	63.5	767	12.08
1953	70.8	789	11.14
1954	74.7	828	11.08
1955	81.2	801	9.86
1956	91.2	818	8.97
1957	96.8	915	9.46
1958	115.0	1044	9.08

gives the output of bauxite and aluminium from selected countries of the world in certain past years

Utilization

Bauxite is the basic raw material, from which aluminium metal is extracted; the metal further finds numerous applications. Bauxite is also used in the manufacture of refractories used as the lining for furnaces. The high alumina content refractories stand a very high temperature. Alumina refractories find wide applications in the cement, matallurgical and several other high temperature industries. In petroleum refineries, bauxite is used as an effective filtering medium. In chemical industries, bauxite

is used as a raw material for the manufacture of alums and aluminium compounds. Some of the aluminium compounds find applications in water-proofing compositions, dyeing, calico printing and other industries. Activated alumina, a product of great indutsrial importance, is also produced from bauxite. Bauxite is also used as a raw material for the production of alundum, an artificial abrasive.

Aluminium is classified as a general purposes metal like iron. It is extensively used as a material of construction for road, rail and air carriers. Aluminium is also used in the construction of electrical transmission lines. Equipments for rail-road transport are made out of aluminum alloys. In the form of sheets, circles,

TABLE No. 17

Quantity and Value of Aluminium Imported into India

Year	*Quantity* Tons	*Value* Rs. Lakhs
1935-36	3176	45.12
1936-37	3163	43.44
1937-38	3342	52.70
1938-39	2892	46.30
1939-40	1530	31.56
1940-41	1333	37.67
1941-42	270	9.01
1942-43	21	0.52
1943-44	16	0.41
1944-45	1361	24.19
1945-46	5478	90.22
1946-47	11709	193.34
1947-48	12446	286.95
1948-49	9453	265.59
1949-50	6690	185.05
1950-51	10540	290.28
1951-52	9354	321.51
1952-53	6069	241.52
1953-54	5455	181.05
1954-55	12380	360.82
1955-56	15305	477.45
1956-57	13824	550.39
1957-58	20229	778.41
1958-59	19016	578.51

foils, tubes, rods, wires and cables, the aluminium metal finds several other industrial and commercial uses. Utensils for household purposes are also made out of aluminium. Aluminium powder is extensively used in paints and leather industries.

Country's requirements of aluminium in the pre-war years were entirely met through imports from foreign countries. It was from 1943 that the indigenous production started satisfying a part of country's demand for aluminium. TABLE No. 17, gives the quantity and value of aluminium metal imported from foreign countries since 1935-36, the main sources of supply being, Canada, the U.S.A., Norway, Yugoslavia, Austria, the U.K., Germany West, Netherlands, Japan, and certain other continental countries.

Country's annual requirement of aluminium in the pre-war years was of the order of 3000 tons, while the current demand has been estimated at nearly 25000 tons per annum. In war years, the consumption of the metal was suppressed but on revival of the import channels after the war, a remarkable increase took place in the indigenous consumption of aluminium.

In India, the aluminium production had steadily risen in the pre-Plan period. The progress made by the industry during Plan years was quite marked. TABLE No. 18 below gives the production of aluminium, in India from 1946 onwards.

TABLE No. 18

Production of aluminium in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1946	3.24	65.77
1947	3.22	65.37
1948	3.37	68.37
1949	3.49	70.84
1950	3.59	72.88
1951	3.85	115.47
1952	3.57	105.20
1953	3.76	105.98
1954	4.86	144.59
1955	7.22	225.39
1956	6.50	224.15
1957	7.78	294.55
1958	8.19	309.85

The average annual rise in output was 12 per cent during the period under review, the increase was only 3 per cent per annum in pre-Plan Years but roughly 22 per cent in the Plan year. The per ton value of metal also recorded a substantial increase during that period. Apart from domestic consumption of the metal and its ore, a part of it is annually exported out of India. The main markets for bauxite are: Germany West, Netherlands, Japan, Pakistan, Iran, Italy and certain other countries, while, the aluminium metal is exported to Ceylon, Aden, Rhodesia South and certain middle-east countries. TABLE No. 19, below gives the quantity and value of bauxite and aluminum exported from India, since 1951-52.

TABLE No. 19

Quantity & Value of Bauxite and Aluminium Exported

Year	*Bauxite*		*Aluminium Metal*	
	Tons (000)	Rs. Lakhs.	Tons	Rs. Lakhs.
1951-52	1.5	1.45	829	49.38
1952-53	4.3	3.27	921	56.57
1953-54	2.7	3.16	1325	87.43
1954-55	2.4	1.98	1055	59.63
1955-56	9.5	6.73	821	49.69
1956-57	5.3	3.89	269	16.40
1957-58	16.2	7.50	15	1.38
1958-59	14.6	5.89	11	1.17

India can earn sizable foreign exchange from out of the export of bauxite and aluminium. Enough bauxite is available for export, but much metal cannot be spared for that purpose.

The indigenous production of aluminium has shown a considerable expansion in recent year. At the same time, the domestic demand for aluminium has also been growing, with the result that every year large quantities of the metal are imported.

The problem of stepping up indigenous production of aluminium, the curtailing of its imports and restricting the con-

sumption of the metal within the country can be attempted simultaneously. The production of aluminium metal and its alloys can be reasonably expanded, as the raw material resources of the country are quite large; the production target of 25000 tons of aluminium per annum having been already fixed under the Second Plan. Large supplies of bauxite can also be assured even for the expansion of chemical and refractory industries.

BERYL

Beryl, the beryllium ore, is found associated with mica. In nature it occurs in the pegmatite veins, as silicate of aluminium and beryllium. Chemically, beryl yields about 12 to 14 per cent BeO.

In India, beryl is found in Ajmer–Merwara (Rajasthan). It is also found in the mica mines of Hazaribagh and Nellore districts. The mica deposits of Udaipur also yield certain quantity of beryl.

India was once the world's only source of beryl supply, but in 1946, the Government of India imposed an export embargo on beryl. World production of beryl mainly comes from India, Brazil, Argentina, Belgian Congo, South Rhodesia, Mozambique, South West Africa, Australia and certain other countries. Of the total world output of about 10.3 thousand tons of beryl in 1957; nearly 90 per cent of the production came from India, Brazil, Argentina and the African countries. TABLE No. 92, in the appendix, gives the output of beryl from selected countries from 1947 to 1957.

Beryl is a product of strategic importance. Alloyed with copper, beryllium is utilized in the manufacture of aircraft instruments, electrical contacts and radio radar devices. Beryllium-nickel alloys find use in the production of special types of diamond drills, watch-balance wheel and certain aeroplane parts. Beryl also finds a small use in ceramic industry. Pure beryllium is used in X-Ray tube windows, and as a moderator and reflector of neutrons in the atomic energy field. Beryllium compounds also find numerous other uses in industry.

The applications of beryl in the nuclear field are gradually expanding. It is hoped that, in due course, India will be able to utilize her vast resources of beryl in an affective manner. As a matter of fact, India occupies a significant position in the world, because of her potential reserves of beryl.

BISMUTH

Bismuth occurs in natural form as sulphide, popularly known as bismuthinite. Sometimes, it is found as an oxidised ore, known as bismite. Bismuth is also found associated with other elements and occurs as complex compounds.

In India, minor occurrence of bismuth is reported from the copper ore deposits of Singhbhum district in Bihar. The sulphide ore is also known to occur at Malthol near Purlia around the Bengal-Bihar border. Bismuth ore associated with manganese ore is also found at Siri near Kulu in the Punjab. In Nepal, the nickel-cobalt ores of Bhorle are also reported to contain certain quantity of bismuth. Most of the reported ore deposits are of little commercial value.

World production of bismuth mainly comes from Mexico, Peru, Korea, Yugoslavia, Japan, Canada and certain other countries. TABLE No. 93, in the appendix, gives the output of bismuth from selected countries of the world from 1947 to 1957. The total world production of bismuth in 1957 was estimated at 4.8 million pounds, of which nearly 30 per cent came from Mexico and Peru.

Bismuth is an important constituent of a number of low-melting alloys. It improves the casting properties of metals like tin and lead. Bismuth, as a hardening agent, finds use in the production of plates for storage batteries. Minor quantity of bismuth, in certain types of iron and steel castings, gives products which can be machined easily. The low-melting-point eutectic alloys find vast application in fusible safety devices. Bismuth alloys can be sprayed to give protective coating on wood and metallic surfaces. More recent uses of bismuth and its alloys are in the nuclear field in the development of power reactors. Bismuth compounds find important uses in medical pre-

parations. The common bismuth compounds are the oxide, carbonate, oxychloride, nitrate and sub-nitrate of bismuth, and certain other organic compounds. Bismuth, in metallic form, has recently been tried with success, in dyeing industry.

The country's demand for bismuth alloys and compounds is mostly met from foreign sources, such as the U.K., Germany West, France, Japan and China. In 1958, India imported nearly 1.25 thousand pounds valued at Rs. 17 thousand of bismuth compounds, as against, the imports of 25 thousand pounds valued at about Rs. 3 lakhs in 1957. There is, however, no indigenous production of bismuth in India. The question of bismuth ore production and the extraction of metal from that can be considered only after the known ore reserves prove to be of some economic value.

BORON

Boron is a widely distributed element in nature. Borax and kernite, the chief sodium compounds of boron, are found in the natural form. Other complex compound of boron containing magnesium and calcium are also known to occur.

In India, borax deposits of commercial value are not quite known. Borax is, however, known to occur, around the Tibetan border, stretching from the valley of Puga, a tributary of the Indus, in Rupshu area of Kashmir into Hundes of South Western Tibet, particularly, between the Roksum and the Chaka lakes. Borax is also reported from in the sulphur springs of Ladakh.

Some of the important boron mineral deposits of the world, are in Peru, Chile, Bolivia, Argentina, Turkey, Germany and Tibet.

Utilization

Boron compounds find numerous applications in industry and commerce. Borax is an excellent fluxing agent and is used in some of the metallurgical operations for smelting and refining of certain metals. It is extensively used in glass, enamelling and ceramic industries. On account of its cleansing properties, it has wide application in washing and for laundering purposes. Boron

compounds are also used in medicine and pharmacy. Being a mild antiseptic and fungicide, it finds use both in industry and agriculture. Boric acid, another important compound of boron, has important uses in medicine and industry.

Presently, borax is imported from foreign sources like the U.S.A., Italy, Belgium, Germany West and certain other countries. TABLE No. 20 below gives the past imports of borax, since 1935-36. Nearly 302 tons of boric acid valued at Rs. 3.33 lakhs were imported into India in 1958, as against 875 tons valued at Rs. 8.28 lakhs in 1957; the imports mainly came from the U.S.A. and the U.K.

TABLE No. 20

Quantity and Value of Borax Imported into India

Year	*Quantity* (000) Tons	*Vaule* Rs. Lakhs.
1935-36	1.61	3.09
1936-37	1.27	2.64
1937-38	1.62	3.62
1938-39	1.30	3.00
1939-40	1.67	4.87
1940-41	1.22	4.69
1941-42	1.65	7.51
1942-43	1.95	10.14
1943-44	1.61	9.92
1944-45	2.69	16.13
1945-46	1.43	6.71
1946-47	1.40	6.73
1947-48	9.09	40.54
1948-49	1.43	6.41
1949-50	1.77	7.39
1950-51	1.55	7.44
1951-52	7.55	39.96
1952-53	10.05	0.32
1953-54	1.98	11.01
1956-57	4.22	24.98
1957-58	4.31	28.20
1958-59	5.17	40.93
1954-55	3.80	20.38
1955-56	3.84	21.69

On an average, India's annual consumption of borax has been of the order of 2000 tons, though in certain years, abnormal imports of borax were made. The demand for borax is likely to expand with an increased industrial activity in the country.

Borax deposits of Kashmir are reported to be of some commercial importance. The exploitation of those deposits should be given a priority in the mineral development programme of the country.

CADMIUM

Cadmium is a rare element. It occurs mainly as sulphide, and is generally found associated with zinc ores. It is generally recovered as a by-product from the zinc concentrates.

In India, a minor quantity of cadmium is found in the zinc concentrate from the Zawar mines of Rajasthan. In Kashmir, the zinc blende deposits near Darabi in Riasi tehsil are reported to contain certain amount of cadmium. The prospects of recovering cadmium from these sources still remain to be examined.

World's chief producer of the cadmium ore are the U.S.A., Mexico, Canada, South West Africa, Germany West, Australia, Poland, Belgium and certain other countries. TABLE No. 94, in the appendix, gives the cadmium output from the principal producing countries of the world. More than 50 per cent of the total world production of cadmium comes from the U.S.A.

A fine layer of cadmium gives a protective coating, hence, it is largely used for electroplating purposes. The electrodeposited coating of cadmium is resistant to alkali and salt. The cadmium electroplated articles possess a fine metallic surface of highly superior physical and chemical character compared to certain other metallic surfaces. Cadmium is also used in the production of a number of low-melting alloys, solders and bearing alloys. Cadmium sulphide is a popular pigment used in paint, enamel, soap, rubber, glass, ceramics and other industries. Some of the cadmium compounds are used in photographic films, lithography and for engraving purposes. In nuclear physics, cadmium is also used to control the fissionable elements in

reactors. Cadmium also finds a number of other commercial and industrial uses.

There is no indigenous production of cadmium or its ores in the country. The country's present requirements of cadmium sulphide are met through imports from the U.K., the U.S.A. and Germany West. In 1958, nearly 6.5 tons of cadmium sulphide valued at Rs. 1.08 lakhs were imported into India, as against 19 tons valued at Rs. 1.9 lakhs in 1957. Since cadmium is in short supply in the whole world, there is a point in recovering this metal from the indigenous zinc ore deposits along with the concentrate production. This is a proposition worth examining.

CHROMITE

Chromite, the chrome ore, is the double oxide of chromium and iron. On theoretical basis, the ore contains about 68 per cent Cr_2O_3, while the commercial grades, usually, contain less than 50 per cent of chromium oxide; ore containing more than 48 per cent is classified as first quality ore.

Production

In India, the chromite deposits are, chiefly, found in Keonjhar and Cuttack districts of Orissa, the west of Chaibasa and Singhbhum district of Bihar, Hassan and Mysore districts of Mysore State. Deposits of lesser importance are also known in Ratnagiri district of Bombay, Krishna district of Andhra Pradesh and in Salem district of Madras. The total proved reserves of chromite in India are placed at 1.3 million tons. The production of chromite from 1935 onwards may be seen from the TABLE No. 21, given on the next page.

Wide fluctuations in ore production took place from 1935 to 1957. That was, perhaps, due to the varying foreign demand for the product. A big drop in production was, however, noticed after the partition of the country in 1947, when quite a fair proportion of chromite reserves was allocated to Pakistan. The industry was able to revive its production efforts only during the First-Plan period. A new record in ore production was attained in 1955. The increases in ore production, in recent years, was

TABLE No. 21

Production of Chromite In India

Year	Quantity Tons (000)	Value	
		Total Rs. Lakhs.	Average Per Ton Rs.
1935	39.1	4.80	12.27
1936	49.5	6.05	12.41
1937	62.3	8.36	13.42
1938	44.1	6.83	13.42
1939	49.1	6.36	15.49
1940	55.5	7.43	13.31
1941	50.1	9.02	18.14
1942	49.6	9.40	18.95
1943	33.3	6.47	19.43
1944	39.6	7.07	17.86
1945	31.1	6.78	21.80
1946	44.8	9.85	22.00
1947	34.7	9.98	28.76
1948	22.6	7.06	31.23
1949	19.4	6.25	32.22
1950	16.7	5.69	34.07
1951	16.7	9.13	54.67
1952	35.2	18.37	52.19
1953	64.8	25.30	39.04
1954	45.5	13.06	29.89
1955	89.3	27.31	30.57
1956	52.7	17.52	33.26
1957	78.5	29.20	37.29
1958	60.4	27.18	45.00

due to a substantial rise in domestic consumption and on account of its export markets having been enlarged. In recent years, the pit-head value of the ore also registered a considerable rise.

The principal chromite producing countries of the world are: the Union of South Africa, Turkey, the U.S.S.R., Philippines, Southern Rhodesia, New Calendonia, Yugoslavia, Canada and Cuba, Small production also comes from India, Greece, Cyprus, Japan, Iran, Pakistan and other countries. TABLE No. 95, in the appendix, gives the production of chromite from selected countries of the world from 1947 to 1957.

Utilization

Chromite finds an important use in the manufacture of chrome steel and other ferro-alloys. Chrome alloys usually stand high temperature and possess high electrical resistance. Nichrome, the nickel-chromium alloy, finds an extensive use as a heating element in electrical appliances. Thermocouples, needed for high temperature measurement, are also made from chrome-alloys. Chrome steels are used in the production of high speed tools. Chromite is also used, in fair quantity, in the manufacture of refractory bricks for use, as high temperature furnace lining. The ore is also a basic source of metal chromium and several of its chemical compounds. Chromium plating is very popular in automobile industry and other industrial and commercial electroplating jobs. Among the chemical compounds, the chromates and bichromates of sodium and potassium find vast applications in dyeing, calico printing, leather tanning and pigment manufacturing industries. In some of the chemical processing industries, the chromium compounds are used as oxidizing agents.

In India, the consumption of chrome ore in steel industry has been steadily rising, as is evident from the TABLE No. 22 below.

TABLE No. 22

Consumption of Chrome Ore by Iron & Steel Industry

Year	*Quantity* Tons (000)	*Year*	*Quantity* Tons (000)
1946	1.9	1951	5.4
1947	3.4	1952	4.7
1948	3.8	1953	4.4
1948	3.8	1953	4.4
1949	3.9	1954	4.9
1950	4.7	1955	5.7

The refractory and chemical industries also consume a fair proportion of chromite production. A considerable proportion of country's output of chromite is also finding market in coun-

tries like the U.S.A., Japan, France, Italy, Netherlands, Norway and the U.K. TABLE No. 23 below gives the extent of chromite exported from India from 1935-36 onwards.

TABLE No. 23

Quantity and Value of Chromite Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1935-36	26.1	7.96
1936-37	22.7	7.20
1937-38	41.5	12.69
1938-39	14.6	5.37
1939-40	29.7	9.19
1940-41	35.6	15.92
1941-42	57.2	27.74
1942-43	41.3	19.90
1943-44	27.1	14.14
1944-45	19.2	9.86
1945-46	14.0	7.76
1946-47	21.9	13.17
1947-48	19.7	14.05
1948-49	2.6	2.35
1949-50	5.2	2.56
1950-51	3.6	3.47
1951-52	8.7	9.37
1952-53	10.3	7.56
1953-54	22.6	22.38
1954-55	17.6	17.02
1955-56	45.1	46.81
1956-57	43.9	45.50
1957-58	50.8	64.34
1958-59	49.8	68.50

India exported a large quantity of chromite during the pre-war and war years, but, after the partition of the country in 1947, she lost some of its foreign chrome ore markets. It was during the latter half of the First Plan, that India was able to expand its export trade in chromite, either by enlarging its existing markets or by creating new ones.

For her domestic requirements, India is still importing chrome refractories from countries like the U.K., Germany West, Netherlands, Italy and the U.S.A. In 1958, the country imported

about 0.55 million chrome bricks worth Rs. 21 lakhs as against 0.40 million bricks valued at Rs. 16 lakhs in 1957.

To a certain extent, it is true that with her known chromite reserves, India can continue to expand her export trade in this commodity for some years, but, after considering the magnitude of the rising domestic demand for this mineral, it may be advisable to make a cautious move in that direction. Perhaps, with her expanding programme of ferrochrome and refractories production, the country may not be able to spare much of the ore for export, particularly, the high grade product. There is, however, an ample quantity of low grade ore which on upgrading can be utilized with an equal advantage. With new ore findings, it may be possible to draw an optimistic export programme of this mineral, but, at no stage, the question of conservation of chromite be relaxed, as it is a mineral of strategic importance.

CLAYS

Clays are the hydrated silicate of alumina and magnesia, containing varying amount of different impurities. The classification and gradation of clays is usually based on their physical properties, like the plasticity, fineness, appearance, colour, thermal resistance and shrinkage. Ordinary clay is the silt dug out of water beds of wells, ponds, lakes and rivers. Other common varieties of clays are the china clay, fire clay, ball clay, pottery clay, bentonite, fuller's earth, etc.

China clay is a white plastic clay, whereas fire clay is the plastic clay, having high thermal resistance. Bentonite and fuller's earth are the non-plastic clays and can absorb colouring matter from liquids.

Silt, muddy soils and ordinary clays are found in abundance everywhere in the country, but china clay, fire clay, bentonite and fuller's earth are available only in a few specific places. A brief account of some of the clays is given below.

CHINA CLAY AND FIRE CLAY

China clay deposits are widespread in different parts of the country. Good quality china clay is found in the districts of

Bhagalpur, Santhal Parganas, Ranchi and Singhbhum in Bihar; Cuttack and Mayurbhanj districts in Orissa; Gird, Jabalpur and Satna in Madhya Pradesh; Cannanore, Malabar and Quilon districts in Kerala; Chanda, Mehsana and Sabarkantha districts in Bombay; Bangalore, Hassan and South Kanara district in Mysore; Adilabad, Anantapur, Cuddapah and Kurnool districts in Andhra Pradesh; and in Delhi State. Small deposits of china clay are also known in Bikaner division of Rajasthan and in certain places in Uttar Pradesh.

Fire clay is generally found in the coal-bearing regions of

TABLE No. 24

Production of China Clay in India

Year	*Quantity*	*Value*	
	Tons (000)	Total Rs. Lakhs.	Average Per Ton Rs.
1935	17.4	1.14	6.50
1936	20.0	1.20	6.00
1937	20.0	1.77	8.76
1938	24.0	2.17	9.04
1939	41.6	3.70	8.89
1940	48.0	3.87	8.06
1941	36.8	5.41	14.70
1942	58.0	12.49	21.54
1943	42.1	9.51	22.64
1944	46.5	10.28	22.11
1945	67.3	12.10	18.00
1946	72.9	15.43	21.17
1947	66.6	14.63	21.97
1948	41.2	11.11	26.97
1949	42.4	11.74	27.69
1950	53.6	16.03	29.91
1951	69.1	18.56	26.86
1952	86.0	18.65	21.69
1953	94.4	19.82	21.00
1954	146.1	25.20	17.25
1955	117.5	22.70	18.28
1956	173.1	27.54	15.71
1957	181.0	22.81	12.60
1958	153.0	26.78	17.50

the country. Fire clay deposits are known in Dhanbad, Hazaribagh, Palamau and Ranchi districts of Bihar. In Madhya Pradesh, fire clay is found in Jabalpur, Sahadol and Chandia Elaka area. In Orissa, it is found in Puri and Sambalpur districts. Certain fire clay deposits are reported from Bombay, Andhra Pradesh and Madras State. TABLES 24 and 25 give the production of china clay and fire clay in India in certain past years.

TABLE No. 25

Production of Fire Clay in India

Year	*Quantity*	*Value*	
	Tons (000)	Total Rs. Lakhs	Average Per Ton Rs.
1942	103.5	2.38	2.30
1943	106.6	2.64	2.49
1944	88.1	2.50	2.84
1945	80.5	3.28	4.07
1946	71.6	3.40	4.75
1947	98.5	9.95	7.06
1948	121.7	8.65	7.11
1949	106.4	8.37	7.86
1950	123.4	8.58	6.95
1951	112.6	8.00	7.10
1952	119.0	9.36	7.87
1953	83.6	6.28	7.51
1954	92.6	7.70	8.31
1955	87.5	6.94	7.93
1956	139.0	11.49	8.34
1957	164.0	12.64	7.70
1958	214.0	17.47	8.16

With the exception of certain breaks during war years, the china clay output in the past was generally rising. In a period of about 24 years the china clay production had gone up by 10 times. Abnormally high output shown from 1954 was due to the inclusion of white clay.

In recent years, the fire clay output registered a considerable rise. Compared to 1942, the output in 1952 was higher by about 10 per cent, but by 1958 it was more than double. The per ton value of the clay, during the period under review, also recorded a considerable rise.

Ordinary muddy clay finds use in brick manufacture and is indispensable to constructional work. Fire clay is a useful refractory material, utilized in the production of fire bricks and other high temperature linings. Certain clays are also used in the manufacture of portland cement. China clay is widely used

TABLE No. 26

Quantity and Value of China Clay Imported into India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1935-36	26.52	11.31
1936-37	19.98	8.79
1937-38	28.62	12.84
1938-39	29.88	14.78
1939-40	33.32	19.26
1940-41	13.57	6.21
1941-42	6.16	6.02
1942-43	3.17	3.79
1943-44	0.27	0.44
1944-45	0.09	0.19
1945-46	0.43	0.73
1946-47	0.35	0.64
1947-48	0.69	1.17
1948-49	2.71	4.36
1949-50	1.96	2.50
1950-51	3.72	6.06
1951-52	6.37	12.25
1952-53	10.84	17.93
1953-54	9.67	15.78
1954-55	14.41	20.61
1955-56	11.18	19.90
1956-57	7.90	16.76
1957-58	6.44	13.74
1958-59	4.69	10.48

in the ceramic industry, particularly, in pottery, earthenware, tiles and glazed earthenware pipes and sanitary fittings, telegraph insulators, domestic crockery and ornamental wares. China clay, in finely powdered form, is used as a filler in the paper, textile and rubber industries. It is also used in paint manufacture and as an adulterant in soap industry. Kaolin, a pure variety of china clay, has certain medicinal uses.

India's requirements in finer quality of china clay are met through imports from the U.K., France, Germany West and certain other countries. TABLE No. 26 gives the quantity and value of china clay imported from abroad since 1935-36.

Apart from china clay, India is also importing every year fire clay, earth clay, ball clay and other clays from the U.K. Germany West, the U.S.A. and other countries. Manufactured products, like pottery are imported from the U.K., Japan, China, Germany West, Hong Kong and other countries. Fire bricks are imported from the U.K., Germany West, Denmark, Netherlands, Belgium, France, Italy, Japan and other countries. TABLE No. 27 below gives the value of clays and products manufactured from clays imported during 1957 and 1958.

TABLE No. 27

Imports of Clays & Manufactured Products

Value Rs. Lakhs

Product	1957	1958
Fire clay	1.56	1.03
Ball clay	5.18	5.80
Earth clay	1.54	0.92
Other clays*	2.02	0.99
Pottery	14.80	3.23
Fire Bricks	116.83	145.30

* Excluding china clay and bentonite.

Clays of different types are abundantly available in the country but the quality of the clays produced differs from place to place. Clays are some times siliceous and gritty and are required to be refined before use. Clay producers can definitely improve the quality of their products, particularly, the china clay, if they equip themselves with refining units.

BENTONITE AND FULLER'S EARTH

Chemically, bentonite is a hydrated magnesium aluminium silicate. Bentonite is chiefly used in foundries, and in soap and ceramic industries. It is also used for filtering and decolourising oils, and for thickening mud in oil well drilling.

India's chief deposits of bentonite are found in Kashmir and Jodhpur. TABLE No. 28 below gives the output of bentonite from 1945 to 1956.

TABLE No 28

Production of Bentonite in India

Year	*Quantity* (000) Tons	*Value* Rs. (000)
1945	0.04	0.1
1946	0.09	0.2
1947	0.31	0.4
1948	0.16	1.1
1949	0.45	13.5
1950	0.13	6.6
1951	0.16	3.7
1952	0.37	15.0
1953	0.36	11.2
1954	0.29	4.3
1955	0.60	22.0
1956	4.00	40.0

The bentonite production in India has been generally, on a small scale. Except in 1956, the output of bentonite never exceeded a few hundred tons in the past. The country is also importing bentonite from the U.K., Germany West, France, Italy and the U.S.A. In 1958 India imported bentonite worth Rs. 15 thousands as against that of Rs. 34 thousands in 1957.

Fuller's earth is a specific variety of clay, non-plastic in character, does not disintegrate in water and absorbs colouring matter from oils It is similar to bentonites in activity, but is of a non-swelling type. Fuller's earths are graded according to their volatile contents, density, acidity and the particle size. Oil

hydrogenation industry is a regular consumer of fuller's earth. It also finds use in the manufacture of perfumed talcum powders for body perspiration.

In India, fuller's earth is obtained from Bikaner, Jodhpur, Jaisalmer, and Jaipur in Rajasthan. The annual production of bentonite was hardly a few thousand tons, in India in the past, as is evident from the TABLE No. 29.

TABLE No 29

Production of Fuller's Earth in India

Year	*Quantity* Tons (000)	*Value* Rs. (000)
1935	7.6	82
1936	6.6	72
1937	7.4	75
1938	11.9	111
1939	9.8	90
1940	13.2	104
1941	9.2	85
1942	8.9	88
1943	10.5	152
1944	11.1	215
1945	13.2	212
1946	9.4	169
1947	2.8	29
1948	6.0	173
1949	4.9	50
1950	4.6	45
1951	4.0	63
1952	8.1	22
1953	4.9	95
1954	1.3	13
1955	7.8	627
1956	5.5	196
1957	4.6	179

The production of fuller's earth came down after the partition of the country as the bulk of it used to come from Sind.

In India, little attempt is made to produce bentonite and fuller's earth of proper grades. Producers hardly adopt stand-

ard methods of refining and activation of crude earths. The indigenous stuff in the market is found adulterated and is usually inferior in quality. Fuller's earth and diatomaceous earths are imported from the U.K., the U.S.A., Germany West and other countries. In 1958, India imported fuller's earth worth Rs. 1.85 lakhs as against Rs. 3 lakhs in 1957. Diatomacious earth imported was worth Rs. 3.85 lakhs in 1958 and Rs. 2.36 lakhs in 1957.

India's vast resources of clays can be properly utilized if attempts are made to refine and up-grade clays to standard specifications. The Indian Bureau of Mines can usefully help the clay producers by propagating the up-grading technique and in bringing about an improvement in their porducts.

COAL

Coal, the complex carbonaceous mineral of vegetable origin, is a chemical product having fixed carbon and volatile organic matter with varying ash and moisture contents. Coals are usually graded according to their chemical composition, physical characteristics and the calorific value. The usual nomenclature of coals, for classification purposes, is: anthracite, bituminous, peat, lignite, etc.

Production

In India, the coal deposits have certain definite geological structure which is intimately linked with their general behaviour. They belong to the Gondwana and Tertiary system. Coal deposits of the Gondwana system are found in Bihar, Bengal and Orissa; the deposits extending to Andhra Pradesh, Bombay and Madhya Pradesh. The Tertiary coals are found in Assam, Rajasthan, Kashmir and certain places in South India.

Coal mining activity in India is at present confined to coal-Bokaro, Darjeeling, Giridih, Jainti, Jharia, Karanpura, Daltonganj, Ramgarh, Rampur, Raniganj, Rajmahal, Talchir, Hutar, in Bengal, Bihar and Orissa fields; Singareni in Andhra Pradesh; Chanda, Yeotamal and Nagpur in Bombay and Bilaspur, Korea, Pench Valley, Raigarh, and Rewa in Madhya Pradesh. The tertiary coals are found in Bikaner (Rajasthan) and around Khasi

and Jainti Hills in Assam. The lignite deposits are, however, spotted in certain parts of Madras and Kashmir.

The coal reserves of India of the gondwana system of both coking and non-coking variety have been estimated at 2,000 and 20,000 million tons respectively, while the tertiary coals including the lignite are placed at 5,000 million tons.

In India, the coal production had steadily gone up in the past. TABLE No.30, gives the coal output, in India, from 1935 onward.

TABLE No 30

Production of Coal in India

	Quantity	*Value*	
Year	Million Tons	Total Rs. Crores	Average Per Ton Rs.
1935	23.02	6.52	2.83
1936	22.61	6.25	2.75
1937	25.04	7.81	3.75
1938	28.34	10.64	3.75
1939	27.77	9.87	3.56
1940	29.39	10.52	3.56
1941	29.46	10.77	3.62
1942	29.43	13.09	4.44
1943	25.51	16.95	6.62
1944	26.13	27.24	12.78
1945	29.17	32.81	14.20
1946	29.77	35.74	12.00
1947	30.14	43.77	14.56
1948	30.12	45.21	15.00
1949	31.70	47.56	15.00
1950	32.31	46.70	14.45
1951	34.43	50.48	14.75
1952	35.30	53.62	14.77
1953	35.98	52.77	14.67
1954	36.88	53.91	14.62
1955	38.23	56.03	14.76
1956	39.43	63.54	16.12
1957	43.50	81.40	14.11
1958	45.34	86.60	19.17

Compared to 1935, the output of coal in 1958 was higher by 97 per cent. Roughly, the annual rate of expansion was 4 per cent. With minor fluctuations during certain pre-war and war years, the output of the industry showed rising trends. The rise in pit-head value of coal by 1943 was roughly one and a half times that of 1935. A phenomenal rise in pit-head value of coal was noticed from 1944.

The main coal producing countries of the world are: the U.S.A., the U.K., the U.S.S.R., Germany West, Poland, France, India, Belgium, Japan, the Union of South Africa, Czechoslovakia, Saar, Netherlands, Australia and Canada. Other coal producing countries are: Southern Rhodesia, Brazil, Chile, Colombia, Indonesia, Mexico, Nigeria, Korea, Hungary, Italy and Yugoslavia. TABLE No. 96, in the appendix, gives the production of coal and lignite from 1947 to 1958 from certain selected countries of the world. Of the total world output of 1.6 thousand million tons in 1957, nearly 70 per cent of coal production came from the U.S.A., the U.K., the U.S.S.R., and Germany West; the rest 30 per cent was from other countries of the world. The Indian coal output was only about 2.5 per cent of the total world production in that year.

As regards lignite production, the world's main sources of supply are: the U.S.S.R., Germany East, Germany West, Czechoslovakia and Yugoslavia. Production on a smaller scale also comes from Hungary, Australia, Rumania, Bulgaria, Austria, Poland, the U.S.A., France, Canada, Japan and certain other countries.

Utilization

Coal is a potential form of energy, and in one form or the other, it enters into the economic structure of almost all industries and public utility services. Coal is extensively used as a fuel in both metallurgical and non-metallurgical industries. A considerable proportion of country's coal prdouction is consumed by railways for steam raising purposes.

Coal is also carbonized under different conditions to yield coke and volatile matter from which liquid and gaseous products are recovered, to yield other forms of fuels and chemical pro-

ducts. Coal and coal tar distillates act as the base for a number of organic compounds including dyestuffs and drugs. A few of the important products are: coke, crude benzol, crude naphtha, motor benzol, rectified motor spirit, benzene, toluene,, pyridin, creosote oil, anthracene, carbolic acid, cresylic acid, naphthalene, etc.

In India, the pattern of coal consumption is much different from that of industrially advanced countries of the world. For instance, India is very much deficit in her supplies of coking coal needed for metallurgical purposes. That coal is, at present, used for non-metallurgical purposes; the railways being the largest consumers of that. TABLE No. 31 gives the extent of coal despatched to important consumers in certain past years.

In a period of ten years, there was an overall increase of about 46 per cent in coal despatches. Of the total despatches, the railways take up 37 to 38 per cent, the power supply stations consume 10 per cent and the steel industry consume further 10 per cent; the rest is taken up by other industries, including bunkers and exports. In ten years, with the exception of jute mills, the consumption of coal in all other industries had considerably gone up; the increase in the case of railways being 55 per cent, iron and steel 27 per cent and in power stations 77 per cent. The consumption of coal by chemical industries, cement manufacture and brick burning had also shown a considerable rise during the period under review.

Coal is a regular line of export from India, its main markets being Pakistan, Ceylon, Burma, Singapore, Hong Kong, Japan, Korea and certain other countries. TABLE No. 32 gives the quantity and value of coal and coke exported from India from 1935-36 onwards.

India's coal resources being limited, there is a need for sound policy regarding its exploitation and utilization. Wasteful methods of mining should be discouraged, as far as possible. At the same time, attempts should be made to popularize the use of non-coking coals for all industrial purposes other than metallurgical. There is a considerable scope for carbonizing high volatile coals and to produce coke and other by-products including chemicals, synthetic fuels, etc. The coal-tar distillation industry

TABLE NO. 31

Quantity of Coal Despatched by Rail to Important Consumers

Quantity : Million Tons

Consumers	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Total Despatches	25.86	28.07	27.12	29.22	31.18	30.77	32.03	32.94	34.96	37.68
Railways	9.45	10.09	9.90	10.60	11.47	11.60	11.48	12.29	13.32	14.62
Iron & Steel	2.87	3.34	3.62	3.77	3.53	3.37	3.77	3.55	3.40	3.66
Power Stations	1.92	2.09	2.24	2.34	2.57	2.78	2.68	2.94	3.17	3.41
Cement	0.67	0.76	0.92	1.18	1.30	1.36	1.45	1.57	1.75	1.94
Cotton Mills	1.87	1.80	1.67	1.61	1.74	1.70	1.75	1.73	1.80	1.89
Jute Mills	0.64	0.58	0.58	0.49	0.54	0.50	0.48	0.48	0.46	0.42
Engineering Works	0.23	0.28	0.36	0.34	0.35	0.35	0.36	0.36	0.35	0.36
Paper Mills	0.40	0.43	0.44	0.49	0.54	0.52	0.53	0.59	0.60	0.64
Chemical Industries	0.41	0.16	0.19	0.18	0.21	0.23	0.24	0.26	0.56	0.96
Brick Burning	0.68	1.22	1.72	1.34	1.15	1.61	2.04	2.00	2.27	1.98
Indian Bunkers & Exports	1.75	1.52	1.68	2.56	2.75	1.78	1.84	1.88	2.10	2.00

TABLE No 32

Quantity and value of Coal and Coke exported from India

Year	*Quantity* (000) Tons	*Value* Rs. Lakhs
1935-36	199.8	17.33
1936-37	250.9	20.41
1937-38	1028.6	98.97
1938-39	1341-3	136.25
1939-40	2008.9	193.39
1940-41	1940-6	190.05
1941-42	1553.7	155.26
1942-43	326.2	35.61
1943-44	156.8	21.37
1944-45	108.7	22.84
1945-46	146.6	24.59
1946-47	544.6	98.82
1947-48	492.6	158.86
1948-49	1137.4	348.72
1949-50	1247.4	421.52
1950-51	976.9	341.31
1951-52	2426.8	801.76
1952-53	2129.7	726.54
1953-54	1198.7	423.62
1954-55	1964.8	588.14
1955-56	1478.1	431.20
1956-57	1205.6	386.68
1957-58	1686.4	527.18
1958-59	1830.9	558.87

if set up on modern lines, can provide a wide range of organic chemicals basically needed for dyestuffs, drugs and high polymer industries. No doubt, the research work on the economic use of non-coking coals both for metallurgical and non-metallurgical purposes is in progress in the country, but there is a need for quicker and speedy mechanism by which the up-grading of lower coals is done effectively, so as to utilize the available coals efficiently.

COBALT

Cobalt is mainly found associated with copper and nickel and occurs as complex sulphide.

Minor quantity of cobaltite, the sulpharsenide of cobalt, and danaite, the cobaltiferrous arsenopyrites is found at Khetri in Rajasthan. Sulpharsenide ore of cobalt is also known to occur in certain parts of Nepal, but the economics of those deposits has not been worked out. Traces of cobalt and nickel have been found in the manganese deposits of Jhabua state and Nagpur-Balaghat region. A minor quanity of complex sulphides of cobalt is reported from Orissa and Kerala state. The extraction of cobalt has not been attempted in India, as the available ore is not much to take care of.

World's chief sources of cobalt are: Belgian Congo, Canada, Northern Rhodesia, the U.S.A., Morocco and Finland. In 1957 the total world production of cobalt ore (cobalt content) was nearly 16 thousand tons, of which 50 per cent came from Belgian Congo. TABLE No. 97, in the appendix, gives the cobalt production from selected countries of the world from 1947 to 1957.

Cobalt is used in the manufacture of special steels of high magnetic permeability. It is also used in the production of cobalt tungsten carbide and in the cutting steel tools. Cobalt-plating has been attempted on an experimental scale, but with little success. Cobalt salts are used as driers in paints and linoleum. As oxide, cobalt finds use in glass and ceramic industries. A few of the cobalt pigments and enamels are used in jewellery.

Country's present requirements of cobalt oxide are satisfied through imports from the U.K., Belgium and Germany West. In 1958, India imported 21 tons of cobalt oxide value at Rs. 3 lakhs, as against 13 tons worth Rs. 2.27 lakhs in 1957.

India has practically very little cobalt. In fact, the assessment of the known reserves of cobalt has yet to be done.

COLUMBITE AND TANTALITE

Columbite and tantalite are the natural ores of metal niobium and tantalum and are generally found together in small veins associated with oxides of iron and manganese.

These minerals occur in Madurai, Nellore, Salem and

Tiruchirapalli districts of Madras State. Certain deposits are also known in Bihar, Mysore and Kashmir States.

World's resources of these minerals are rather meagre. Nigeria produces large quantity of columbite; the production in smaller lots also comes from Malaya, Norway, Portugal and other countries, whereas certain quantities of tantalite are obtained from Australia, French Guinea, Nigeria and certain other countries. Both of these are found together in Belgian Congo, Brazil, Sierra Leone ,the U.S.A. and South Rhodesia.

Both columbite and tantalite are used in the manufacture of special alloys. Ferrocolumbium or ferrocolumbium-tantalum are used in the manufacture of stabilized stainless steel. Columbium alloys are also used in jet engines, gas turbines and tungsten carbide cutting tools. It has certain uses in nuclear technology. It is a valuable material of construction for chemical equipment and corrosion resistant tools. Tantalum is also used in electronics as anode and grid material for transmitting tubes. Alloys of tantalum also find applications in other technological fields.

Because of their little demand and for want of further research regarding their utility, the indigenous production of these minerals has not been developed in the country.

COPPER ORE

Copper minerals occur mainly as sulphides known as 'Chalcopyrite' and 'Chalcocite' containing varying proportions of copper. Other natural ores of copper are the carbonates and oxides, popularly, known as malachite, azurite, cuprite, etc.

Production

Copper ore mining is carried out at Mosaboni near Maubhander in Singhbhum district of Bihar. Other centres of ore mining are at Rakha and Dhobani. Copper ore deposits are also reported from Rajasthan, at Khetri in Jaipur and Daribo in Alwar. Certain ore deposits are also known in Anantapur and Nellore districts of Andhra Pradesh. In minor quantity, copper ore is also found in Kumaon and Kangra valley in the sub-Himalayan regions. Scattered deposits of copper ore are located in

certain places in Assam, Bengal, Madhya Pradesh, U.P., Madras, Kashmir, Mysore and Sikkim but the reserves are not large enough to undertake mining on a commercial scale. The total estimated reserves of copper ore of some of the mines in Bihar are of the order of 3 million tons with an average assay of about 2.5 per cent copper. The mining activity in the copper ore industry has remained at a steady level during the past several years, as is evident from the TABLE No. 33.

With some fluctuations in output, in certain years, there has been practically no improvement in its production level. While the output of copper ore in the year 1940 and 1958 was of the same magnitude, the per ton pit-head value of the ore registered a rise of about three times.

TABLE No. 33

Production of Copper Ore in India

Year	*Quantity* Tons (000)	*Value* Rs. lakhs
1935	307.7	61.45
1936	318.6	60.13
1937	342.6	72.90
1938	271.1	48.52
1939	360.6	47.81
1940	401.3	73.31
1941	381.5	59.24
1942	363.2	57.26
1943	359.8	61.80
1944	326.0	67.27
1945	329.3	70.99
1946	352.7	71.70
1947	323.0	60.34
1948	322.3	80.44
1949	329.3	110.53
1950	360.3	120.26
1951	369.1	194.00
1952	324.6	163.46
1953	238.0	114.13
1954	342.8	187.23
1955	353.1	257.59
1956	386.2	289.81
1957	404.0	265.34
1958	405.0	226.68

The chief copper ore producing countries of the world are: the U.S.A., the U.S.S.R., Chile, North Rhodesia, Canada, Belgian Congo, Japan, Australia, the Union of South Africa, Peru, and Mexico. Other countries where copper ore is also mined are: Cuba, Finland, Germany West, Norway, Sweden, Cyprus, Philippines, Turkey, South West Africa and certain other countries. The total world output of copper ore (copper content) in 1957 was nearly 3 million tons, of which one-third of the production came from the U.S.A. TABLE No. 98, in the appendix, gives the production of copper ore and copper metal form some of the selected countries of the world in certain past years.

Utilization

Chief consumers of copper metal are the electrical industry, automobile industry, telephones and telegraphs. Copper is also used for railway equipment, building projects, ship building industry and other engineering works. The popularity that the copper metal enjoys, is mainly attributed to its high thermal and electrical conductivity, high tensile strength and ductility. It is fairly resistant to atmospheric corrosion. In India brass (copper-zinc) and bronze (copper-tin) alloys and copper metal are invariably used for kitchen utensils. The nickel-copper alloy (monel metal) is largely used as a material of construction in chemical industry. Copper wire is an indispensable material used in electrical installation projects. Millions of tons of copper wire are spread over the entire globe for telegraphic and telephonic communications and for conducting electricity from one place to another.

Copper metal in other forms, such as pipes, conduits, sheets, etc. finds use in the manufacture of engineering appliances, machinery parts and as materials of construction in a number of industries. Chemical salts like the sulphate, chloride, nitrate, carbonate, and oxide of copper are important lines of manufacture. Copper-plating salts, the single and double cyanides and the sulphates are of considerable industrial importance.

For her requirements of copper, India has to mostly depend on foreign sources of supply, as the indigenous production of

metal is just a small proportion of its total demand in the country. TABLE No. 34 gives the copper metal production in India from 1945 onwards.

TABLE No. 34

Production of Copper in India

Year	*Quantity* (000) Tons	*Value* Rs. Lakhs
1945	6.00	83.70
1946	5.93	65.57
1947	5.93	88.31
1948	5.86	99.67
1949	6.39	102.24
1950	6.61	162.00
1951	7.08	227.79
1952	6.08	195.51
1953	4.92	145.49
1954	7.16	222.47
1955	7.28	292.20
1956	7.63	333.73
1957	7.85	263.33
1958	7.84	220.43

From an average annual output of 6000 tons during the period 1945 to 48, the copper production had gone up by 30 per cent in 1958. Quite a large quantity of copper metal and alloys is imported from sources like Canada, Rhodesia, North & South, Nysaland, Mozambique, Belgian Congo, the U.K., Germany West, Uganda, Kenya and other countries. TABLE No. 35, on the next page, gives the imports of copper and its alloys, into India from 1935-36 onwards.

The present annual demand of copper is placed at 30 to 35 thousand tons, as against that, the indigenous production is less than one-fourth. The country is very much deficit in her resource of copper. It is indeed necessary to step up indigenous production of copper, as far as possible, and also expedite the prospecting of areas where copper occurrences are reported. The

TABLE No 35

Quantity and Value of Copper Imported into India

Year	*Quantity* Tons	*Value* Rs. Lakhs
1935-36	21698	123.06
1936-37	12339	87.21
1937-38	18622	160.97
1938-39	11110	83.01
1939-40	15520	133.22
1940-41	17165	163.22
1941-42	17496	190.59
1942-43	18330	173.68
1943-44	16311	159.85
1944-45	19126	192.72
1945-46	18803	197.73
1946-47	36214	442.27
1947-48	22963	385.56
1948-49	43225	751.97
1949-50	34482	642.38
1950-51	37491	850.39
1951-52	5816	195.77
1952-53	20591	762.65
1953-54	8532	271.06
1954-55	26980	874.89
1955-56	18122	871.40
1956-57	38637	1761.81
1957-58	51705	1598.34
1958-59	45578	1317.98

exploitation of the Khetri copper deposits should be accorded a top priority. Since there is a limit to which the indigenous production of copper can be expanded, there is an urgent need to restrict the consumption of the metal in the country and also to find out substitutes of the same, in order to minimise dependency on foreign imports of copper metal and its alloys.

DIAMONDS AND PRECIOUS STONES

The evaluation of precious stones is generally based on their external appearance, lustre, colour, shade, refraction power, hardness and specific gravity. The variety of precious stones

available in nature are: diamond, ruby, sapphire, emerald, gem-jade, rock crystal, opal, turquoize, lapis lazuli, etc. As regards chemical composition, a diamond is the crystalline form of carbon, whereas other stones are mainly the complex silicates.

Production

Precious stones are usually found associated with other inferior stones like garnet, quartz and rocks of identical geological structure. Mining of precious stones is not very common in

TABLE No 36

Production of Diamonds in India

Year	Quantity	Value	
	Carats	Total Rs. Lakhs	Average Per Carat Rs.
1935	1401	0.56	40.0
1936	1457	0.62	42.5
1937	1178	0.55	46.7
1938	1729	0.69	40.0
1939	1604	0.58	38.5
1940	1526	1.34	88.4
1941	2107	1.77	84.0
1942	2823	2.75	97.0
1943	2533	2.97	117.2
1944	1837	2.18	118.7
1945	1381	1.80	137.6
1946	1107	1.77	159.9
1947	1284	1.73	134.7
1948	2426	4.17	171.9
1949	1632	2.75	168.5
1950	2769	4.18	151.0
1951	1674	5.34	319.0
1952	2054	4.78	232.7
1953	2207	5.61	253.2
1954	1955	4.74	242.5
1955	1787	4.05	226.6
1956	1499	3.27	218.0
1957	790	1.68	212.6
1958	1535	3.43	223.4

India, while accidental findings are reported occasionally. Regular diamond mining has been going on, around the Vindhyan regions of Madhya Pradesh, which, in the per-merger days, were originally the independent states of Panna, Ajaigarh, Bijawar, Charkhari, Patharkachar, Kothi, Chobpur and Baraunda. The Majgawan and Shahidan areas around Panna are of particular interest for diamond mining. Other diamond-bearing areas in India are Kurnool, Anantapur, Cuddapah, Krishna, Guntur and Godavari districts of Andhra Pradesh; Chanda and Sambalpur districts in the Mahanadi valley. Rubbies and sapphires are found in Kashmir, emeralds in Rajasthan and rock crystals in Santhal Parganas and in certain other areas in Madhya Pradesh.

Collection of precious stones from water-beds is not very uncommon, as a number of them are some time washed away from rocks by river streams. The finding of the Kohinoor diamond is of historical importance. The avialability of pearls in sea-beds is also a line of similar interest. The formation of pearls is based on marine biology, whereas precious stone formation is the result of geological rock formation. TABLE Nos. 36 and 37 give the quantity and value of diamonds and emeralds, produced in India in certain past years.

The diamond production showed wide fluctuations in the

TABLE NO. 37

Production of Emeralds in India

Year	*Quantity* Carats (000)	*Value Rs.* Lakhs.
1951	253.0	2.57
1952	461.9	2.78
1953	551.0	2.30
1954	509.2	6.70
1955	191.7	6.37
1956	474.4	2.40
1957	338.0	0.25
1958	80.0	0.50

past, as the industry was not well organised. The per carat value of diamond also registered an enormous increase during the period under review.

The Indian industry is insignificant, as compared to the other diamond producing countries of the world, like that of the Union of South Africa, Ghana and Brazil and South West Africa. TABLE No. 99, in the appendix, gives the output from the principal diamond producing countries of the world. Sapphires and emeralds are found in Burma, Ceylon and a number of other countries.

Utilization

Diamond mining is of great national importance, as like gold and silver, its output has a direct monetary conversion value. As industrial abrasive and as important component of drilling equipment and cutting and precision tools, diamonds possess a strategic value.

Precious stones are generally the items of jewellery, and have an ornamental value. Because of their extreme hardness, diamonds possess great industrial value. Inferior variety of diamonds are used in rock drilling machines and for high speed cutting tools and also as abrasives for grinding, cutting and polishing purposes. A major portion of indigenous production of diamonds is consumed for jewellery purposes. The local lapidary industry also consumes a part of it. To some extent, borts and broken diamonds are exported out of India. At the same time, India imports diamonds and diamond drills from foreign countries. India's past imports of diamonds may be seen from TABLE No. 38, the imports mainly come from South West Africa, the U.K., Netherlands, Belgium, Belgian Congo, France and certain other countries.

Diamond mining in India has not proved a real success so far. The industry has, however, been operating on a modest scale. India is a potential market for diamonds. The gap between the demand and supply is pretty wide. On account of ready convertibility of diamonds into money, the smuggling of diamonds into India, has been reported quite often.

TABLE NO. 38

Value of Diamonds Imported into India

Year	Value Rs. lakhs	Year	Value Rs. Lakhs.
1935-36	31.25	1947-48	313.54
1936-37	84.13	1948-49	24.86
1937-38	111.73	1949-50	28.05
1938-39	102.27	1950-51	00.12
1939-40	68.75	1951-52	0.23
1940-41	7.57	1952-53	0.06
1941-42	5.22	1953-54	2.28
1942-43	45.96	1954-55	10.09
1943-44	120.73	1955-56	13.09
1944-45	220.16	1956-57	35.59
1945-46	188.10	1957-58	8.18
1946-47	244.99	1958-59	5.65

India is understood to be potentially rich in her diamond resources. The existing mining units seem to possess inadequate resources to organize a large scale production of diamonds. To overcome that difficulty, the Government of India have decided to nationalize the diamond industry. There is a possibility of intensifying further production of diamonds and organizing the industries on sound lines in due course.

FELDSPAR

Feldspar is the natural complex silicate containing potash or sodium as one of its constituents. The silicate of potassium and aluminium is known as "Orthoclase", while the sodium calcium aluminium silicate is called "Plagioclase". A similar silicate with a high soda content, is known "Napheline Syenite".

In India, feldspar is found in Beawar in Ajmer-Merwara, Alwar, Sirohi and Jodhpur in Rajasthan; Bangalore, Hassan and Kolar districts of Mysore State; Burdwan in West Bengal; Chindwara, Jabalpur, Rewa in Madhya Pradesh; Santhal Parganas and mica bearing areas in Bihar; Tiruchirapalli in Madras; and Gulbarga in Andhra Pradesh. Certain deposits are also located in the Bombay State. The country's present annual output of

feldspar is hardly a few thousand tons. TABLE No. 39 gives the annual output of feldspar in India from 1945 onwards.

TABLE No. 39

Production of Feldspar in India

Year	*Quantity* Tons (000)	*Value* Rs. (000)
1945	0.3	9.4
1946	1.3	10.6
1947	1.7	6.9
1948	1.0	10.5
1949	0.9	11.1
1950	1.8	21.3
1951	3.4	36.9
1952	2.0	29.9
1953	3.9	41.0
1954	6.5	69.9
1955	5.2	57.0
1956	3.3	26.0
1957	7.9	81.0
1958	6.6	70.0

The output of the industry though irregular, in the past, has shown rising trends. There had been a considerable improvement in production efforts during the First-Plan period.

More than a million tons of feldspar are produced every year throughout the world, of which more than 50 per cent of the product comes from the U.S.A. Other feldspar producing countries of the world are: Germany West, France, Japan, Italy, Norway, Sweden, Canada and Australia. Small production of feldspar comes from almost all countries. TABLE No. 100, in the appendix, gives the world output of feldspar by principal producers from 1947 to 1957.

Feldspar finds uses in ceramic and glass industries. It is also a type of soft abrasive. Feldspar industry does not appear to have been properly organized in the country. Irregular demand for the product can be one of the factors responsible for that. At the same time, lack of quality control and the non-availability

of products of a standard quality also affect the demand and consumption of this mineral.

FLUORITE

Fluorite or fluorspar is chemically the fluoride of calcium, and in natural form it is found associated with other impurities.

In India, the fluorite deposits are located at Khairagarh and Nandgaon near Dongargarh. It also occurs at Barla in the Kishengarh state of Rajasthan. The occurrence of the mineral has also been recorded in Jabalpur, Chindwara and Raipur districts of Madhya Pradesh. There is no regular production of this mineral in the country. In the past, the production never exceeded a few hundred tons.

Other fluorite producing countries of the world are: the U.S.A., Germany West, the U.S.S.R., the U.K., Italy, Spain, Canada, Mexico, Germany East and France. Small deposits are known to occur in almost all countries of the world. TABLE No. 101, in the appendix, gives the world output of fluorite. The total world output of fluorite in 1957 was estimated at 1.6 million tons, of which nearly 20 per cent came from the U.S.A.

Fluorite is used as flux in the metallurgical operations, especially steel manufacture, where it is consumed at the rate of nearly 0.2 to 0.3 per cent of the basic steel produced. It acts as a source for fluorine and hydrofluoric acid, and is used in the production of artificial cryolite (sodium aluminium fluoride) required in aluminium metallurgy. In glass and enamel industries, fluorite finds a minor use. It is also a source for potash. It finds use in the paint industry and sometime used as an abrasive.

Country's present requirements of fluorspar are met through imports. The use of this mineral has remained restricted on account of its poor availability within the country.

GOLD

Gold is mostly found associated with quartizite. Sometimes it is recovered from the river sand. In nature gold is widely distributed in minor quantity.

Production

In India, the gold mining and extraction was started at the Kolar Gold Mines in South India in the year 1880. The various mining centres around Kolar are: Mysore, Nundydroog, Champion Reef and Ooregum, Gold, in minor quantity, is also found in Dharwar, Anantapur, Wynaad (Nilgiris) and in Hutti Mines (Andhra Pradesh). Scattered occurrences of gold are also known in Bihar, particularly, the Chota Nagpur region, and also in Madhya Pradesh, Assam and other parts of the country. TABLE No. 40 gives the gold production in India from 1935 onwards.

TABLE No. 40

Production of Gold in India

Year	*Quantity* Ounces (000)	*Value* Rs. Lakhs.
1935	327.7	304.02
1936	333.4	306.02
1937	331.7	304.81
1938	322.3	305.81
1939	314.5	324.34
1940	289.3	324.61
1941	285.9	331.32
1942	260.3	376.83
1943	252.2	508.45
1944	188.2	355.02
1945	168.4	339.65
1946	131.8	348.90
1947	171.7	489.55
1948	180.4	543.20
1949	164.2	499.00
1950	196.9	592.12
1951	226.4	675.30
1952	253.3	604.32
1953	223.4	507.35
1954	239.2	562.07
1955	210.9	530.14
1956	209.0	576.73
1957	179.2	510.69
1958	170.0	499.72

Gold production in India had been mainly coming from the Mysore State. In pre-war years, a small production of gold also came from Burma and Bihar. During war years there was a fall in output. From 1951 there was a definite improvement in gold production. The per unit value of gold however registered an enormous increase. By 1958 the per ounce value was higher by 200 per cent than the 1935 value.

More than fifty per cent of total world production of gold comes from the Union of South Africa. Other gold producing countries of the world are: Canada, the U.S.A., Ghana, South Rhodesia, Belgian Congo, Mexico, Columbia, Australia, Japan and others. TABLE No. 102, in the appendix, gives the world output of gold by principal producers from 1947 to 1957.

Utilization

Gold, being a precious metal, is a product of great international importance. The country's gold reserves are its index of wealth. It is a standard of barter exchange used in international trade. Gold is largely used for making ornaments. As a part of oriental civilization, the Indians possess peculiar sentiments for keeping gold ornaments as personal belongings. In small quantity, gold is also used for making gold leaves needed for decorative purposes. Some of the chemical compounds like the chloride and cyanide of gold find numerous industrial uses. Liquid gold, the complex organic composition of this precious metal, is widely used for decorating glass bangles and pottery.

Gold has always been in great demand in India. Compared to the world price of gold the price level in India has been on the higher side and as a result of that there has been tendency towards gold smuggling into the Indian market. There has been certain imports and exports of bullion gold through the official channels. TABLE No. 41 gives the imports and exports of bullion gold from 1935-36 onwards.

Compared to the imports, India's exports of bullion were pretty large in pre-war and certain war years. In subsequent years, the imports exceeded the exports. The import and export of bullion gold were much restricted in the post-independence period.

TABLE No. 41

Quantity & Value of Gold Imported & Exported

Year	*Imports*		*Exports*	
	Ounces (000)	Value Rs. Lakhs	Ounces (000)	Rs. Lakhs
1935-36	103.46	94.95	4122.72	3830.55
1936-37	172.78	160.88	3182.82	2945.49
1937-38	169.53	155.60	1937.99	1709.24
1938-39	80.36	74.66	1436.20	1380.77
1939-40	157.47	132.73	3314.58	3600.26
1940-41	54.70	65.95	1149.27	1296.59
1941-42	2.94	3.47	186.36	214.99
1942-43	41.95	24.39	30.31	47.95
1943-44	18.91	35.85	10.89	22.50
1944-45	92.75	165.82	4.04	8.22
1945-46	10.99	22.03	21.06	49.95
1946-47	388.57	946.31	103.02	152.25
1947-48	350.47	982.24	0.64	1.84
1948-49	1.09	2.94	0.41	1.87
1949-50	0.72	2.98	..	..
1950-51	7.17	20.87	1.22	3.73
1951-52	40.10	116.12	..	..
1952-53	0.95	2.16	..	..
1953-54	0.86	2.07	..	..
1954-55	2.92	6.67	1.20	2.46
1955-56	3.55	8.99	..	..

In India, the gold mining was nationalized in 1956, and as a result of that, certain improvements are anticipated in the mining programme. It may, perhaps, be too early to know the impact of nationalization on the output and to say anything about the prospects of stepping up production. The prospecting of other known reserves of gold in the country may have to be considered on more serious lines.

GRAPHITE

Graphite as natural carbon occurs both in amorphous and crystalline form.

Production

In India, certain graphite deposits are known to occur in the states of Andhra Pradesh, Orissa, Rajasthan and Mysore.

In Andhra Pradesh, the mineral deposits of commercial interest are known in Vishakapatnam and Krishna districts. In Orissa, graphite depostis are located in the districts of Sambalpur, Bolangir, Koraput and also in certain border line territories of Bihar and Bengal. In Mysore, certain graphite deposits are found in the Kolar region. Other graphite deposits are reported in Beawar, Ajmer and Merwara regions in Rajasthan. Some of the lesser known deposits are in Warrangal (Andhra), Almora (U.P.) and Sikkim regions. Minor occurrences are reported from the Punjab and Kerala State.

In India, graphite mining is being carried out on a modest scale as the quality of indigenous product is inferior. TABLE No. 42, gives the production of graphite in India from 1935 to 1955.

TABLE No. 42

Production of Graphite in India

Year	Quantity Tons (000)	Value Rs. Lakhs
1935	0.56	12
1936	0 39	5
1937	0.56	16
1938	0.46	21
1939	0.94	33
1940	0.31	13
1941	0.81	29
1942	1.06	41
1943	1.13	113
1944	0.93	131
1945	1.30	129
1946	1.63	160
1947	1.24	155
1948	1.65	264
1949	1.14	125
1950	1.59	159
1951	1.74	232
1952	2.88	313
1953	0.77	69
1954	1.48	136
1955	1.61	112

The graphite production showed rising trends in output,

although, the industry operated at quite a low level. The pit-head value of the mineral also showed considerable variations in different years.

The principal graphite producing countries of the world are: Korea, Mexico, Austria, Ceylon, Germany West, Madagascar, Czechoslovakia, the U.S.A. and the U.S.S.R. TABLE No. 103, in the appendix, gives the world production of graphite by principal producers from 1947 to 1957.

Utilization

Graphite is largely used in the production of crucibles for metallurgical and other high temperature operations. It also finds use in foundry moulds. Graphite electrodes, in the form of rods and plates, find wide applications in electric furnaces, arc lamps, electric cells and batteries. Carbon brushes made of graphite are extensively used in electric motors and dynamos. For black lead pencils, graphite is an important ingredient. In small quantity graphite also finds use in paint industry. It is also used as a lubricant for several industrial purposes.

In India, the quality of graphite produced is generally poor. For her requirements, the country has to depend on foreign sources. Ceylon is an important source for the supply of high grade graphite. Other sources of supply being the U.K., Norway, Germany West, Japan, China, Kenya, Madagascar and the U.S.A. A number of finished products made of graphite, such as crucibles, electrodes, carbon brushes and graphite powder are imported into India every year. Graphite crucibles are imported from the U.K., Germany West, Germany East and the U.S.A., graphite bricks from Germany West and the U.S.A., and carbon blocks, brushes and electrodes from the U.K., Germany West, Sweden, Denmark, Netherlands, Switzerland Belgium, France, Japan, China and the U.S.A. TABLE No. 43 gives the quantity and value of graphite crucibles and graphite powder imported into India from 1935-36 onwards.

The quality of the indigenous graphite is not very superior. Developmental work to beneficiate low grade graphite has already been accomplished in one of the National Laboratories, and a process has been perfected to upgrade inferior graphite.

TABLE NO. 43

Quantity and Value of Graphite Crucibles & Graphite Powder Imported into India

Year	Graphite Crucibles		Graphite Powder	
	Quantity Tons	Value Rs. Lakhs.	Quantity Tons	Value Rs. Lakhs.
1935-36	194	1.64	531	1.35
1936-37	174	1.62	528	1.31
1937-38	273	2.44	555	1.56
1938-39	157	1.55	429	1.14
1939-40	97	1.00	525	1.23
1940-41	147	1.66	375	1.46
1941-42	356	4.69	342	1.77
1942-43	180	2.51	759	4.99
1943-44	325	5.73	138	1.24
1944-45	474	7.77	108	0.94
1945-46	421	3.81	589	3.18
1946-47	283	5.88	558	2.77
1947-48	349	7.40	923	5.67
1948-49	495	11.08	604	4.07
1949-50	518	10.95	458	3.31
1950-51	349	7.20	805	5.84
1951-52	289	6.32	147	6.89
1952-53	76	1.56	356	4.55
1953-54	144	2.72	585	4.77
1954-55	180	2.89	458	3.83
1955-56	177	3.61	711	6.82
1956-57	*	11.17	978	7.56
1957-58	*	24.82	963	5.56
1958-59	*	23.73	568	4.95

* Not available.

There is, however, a great urgency to give that technique a commercial shape. Efforts can be made to step up India's own production of graphite and minimise her dependency on imports.

GYPSUM

Chemically, gypsum is the hydrated calcium sulphate ($CaSO_4.2H_2O$). The natural crystalline forms of gypsum are known as "selenite", "gypsite" and alabaster". On heating, gypsum is partially dehydrated at a temperature from 120°C to 170°C, to yield a new product known as "Plaster of Paris". It gets completely dehydrated above 200°C. On reabsorbing the

water of dehydration, the heated product acquires different physical and chemical properties.

Production

In India, extensive deposits of gypsum are known in the Jaisalmer, Jodhpur and Bikaner divisions of Rajasthan. Deposits at Jamsar are of a considerable commercial interest. Gypsum is also found in Madras, Andhra Pradesh, Saurashtra (Bombay), and Madhya Pradesh. Deposits of selenite, gypsite and alabaster are found in different parts of the country. The gypsum mining activity is at present confined to certain areas in Rajasthan, Madras and Uttar Pradesh. TABLE No. 44, gives the production of gypsum, in India from 1935 onwards.

TABLE No. 44

Production of Gypsum in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1935	45.3	0.92
1936	54.4	0.98
1937	46.1	1.19
1938	69.8	1.72
1939	71.2	1.68
1940	78.0	2.40
1941	53.1	2.09
1942	63.4	2.34
1943	82.3	2.73
1944	83.7	3.25
1945	90.8	4.60
1946	88.4	4.53
1947	50.6	4.60
1948	78.9	7.98
1949	139.9	11.18
1950	206.4	13.77
1951	203.6	12.63
1952	411.2	31.02
1953	585.8	39.03
1954	612.1	41.59
1955	689.9	44.81
1956	849.6	50.56
1957	922.0	57.63
1958	790.0	52.20

In earlier years, the gypsum output showed rising trend. On an average, the annual rate of expansion in output was roughly 10 per cent from 1935 to 1945. A considerable drop in output took place in 1947 as, after the partition of the country, a fair proportion of gypsum reserves fell to the share of Pakistan. In subsequent years, the gypsum production was stepped up, as an enormous increase in the consumption of gypsum took place in the fertilizer industry. The production was manifold since 1952 after the Sindri Fertilizer and Chemical Works went into operation. The annual rate of expansion in the output of gypsum after 1951 was roughly 50 per cent. The pit-head value of gypsum was about Rs. 2 to 3 per ton in pre-war years, while in recent years it was about Rs. 6 to 8 per ton.

Gypsum is found in almost all countries of the world. The principal gypsum producing countries of the world are: the U.S.A., Canada, the U.K., France, Spain, Germany West, Italy, India and Australia. Other gypsum producing countries are: Austria, Iraq, Japan, Egypt, the Union of South Africa, Ireland, Cyprus, Jamaica, Chile and certain other countries. TABLE No. 104, in the appendix, gives world production of gypsum by principal countries from 1947 to 1957.

Utilization

Gypsum, being a potential source of combined sulphur, is an important raw material used in the manufacture of ammonium sulphate, sulphuric acid and sulphur compounds. It is also an important ingredient used in portland cement manufacture. In metallurgy, gypsum is used as a flux. It is used as a filler in the paint industry. It also finds certain use in ceramic industry. Plaster of paris, the partially dehydrated gypsum, is largely used in clay modelling and for making moulds for pottery and rubber industries. Plaster models used in biological and science laboratories are of immense educational value. In the field of medical science, bone setting is done with the help of plaster of paris. Bandages prepared out of plaster are also used with equal efficiency.

There has been a considerable rise in the domestic consumption of this mineral in the country. TABLE No. 45 gives the

extent of gypsum consumed in certain past years, by the organized sector of industries like the cement, ceramics and chemical manufacture.

TABLE NO. 45

Quantity of Gypsum consumed by certain Industries

(Quantity 000 tons)

Year	Consuming Industries		
	Cement	Ceramics	Chemicals
1946	30.4	1.4	—
1947	38.7	1.1	—
1949	59.6	1.6	—
1950	84.0	1.6	—
1951	114.1	2.8	—
1952	132.1	1.2	281.7
1953	136.9	2.5	431.7
1954	158.4	3.2	441.0
1955	70.2	2.0	515.8

The gypsum requirements of the fertilizer industry are mounting up at a very rapid rate. At the same time, the requirements of the cement industry have also gone up considerably Compared to 1946, the rise in gypsum consumption in cement industry was more than five time by 1955, while the consumption of the ceramic industry was 100 per cent higher during that period. Of the total gypsum consumed in 1955, the chemical industry absorbed nearly 75 per cent.

The consumption of gypsum by the end of Second Plan is likely to be 1.97 million tons. India's reserves of gypsum are quite modest, and, at the present rate of industrialization, country's entire gypsum reserves may be exhausted in a period of about 50 years or so. The country may fall short of its requirements of gypsum, unless further exploration and surveys are understaken to locate new deposits of the mineral.

IRON ORES

Iron ores are found in abundance in different parts of the country. The ores occur as oxides of iron and as sulphides.

Hematite, magnetite and limonite are the widely distributed oxides, whereas the sulphides more popularly known as iron pyrites are known to occur only at a few places. Superior quality hematite contains about 60 to 70 per cent iron, while the hematite quartizite rock is of 20 to 30 per cent purity.

Production

In India, hematite ore of a rich variety is found in the Singhbhum district of Bihar and in the Keonjhar, Mayurbhanj and Sundergarh districts of Orissa. Iron ore deposits are located in Dhalli-Rajhara, Rowghat and Jabalpur areas in Madhya Pradesh. Other places where iron ore deposits are found are: Dharwar, Bellary, Chickmagalore, Chitaldrug, Shimoga and Tumkur district of Mysore, and Kurnool, Adilabad, Karimnagar, Nizamabad and Warrangal in Andhra Pradesh Small deposits are also known in other States, such as Kashmir, Rajasthan, the Punjab and U.P.

The magnetite ore is found in Salem and Tiruchirapalli districts of Madras and Guntur and Nellore district of Andhra Pradesh, and in small quantity in Bihar, Orissa and Himachal Pradesh. The limonite and spathic ore are found in West Bengal.

India's total iron ore reserves are estimated at 21.6 thousand million tons, of which the proved reserves are roughly 6.8 thousand million tons. The hematite ore accounts for roughly 80 per cent of the total Indian iron ore reserves. Iron ore deposits of India are nearly one-fourth of the total world ore reserves, and are roughly one-third on the basis of iron contents.

Iron ore mining on a large scale is at present confined to certain places in Bihar, Orissa, Mysore, Andhra Pradesh, Bombay and certain other places. TABLE No. 46 gives the iron ore output of the country from 1935 onwards.

The iron ore output was generally steady except some fluctuations in certain war and pre-war years. In post-war period, the industry showed rising trends in production. The rate of production, during the First-Plan period was much faster.

TABLE NO. 46

Production of Iron ores in India

Year	Quantity	Value	
	Million tons	Total Rs. lakhs	*Average* per ton Rs.
1935	2.34	34.58	1.48
1936	2.53	39.12	1.55
1937	2.87	45.86	1.60
1938	2.74	45.57	1.66
1939	3.17	52.21	1.64
1940	3.10	53.31	1.72
1941	3.20	55.57	1.71
1942	3.22	59.92	1.86
1943	2.66	54.95	2.07
1944	2.36	56.06	2.37
1945	2.26	59.58	2.63
1946	2.41	65.08	2.70
1947	2.50	86.68	2.23
1948	2.28	102.99	4.51
1949	2.81	126.66	4.51
1950	2.96	153.69	5.16
1951	3.66	209.53	5.73
1952	3.93	268.33	6.57
1953	3.85	280.90	7.51
1954	4.31	289.36	6.71
1955	4.65	324.55	7.00
1956	4.86	355.03	8.13
1957	5.07	434.34	8.55
1958	5.94	493.81	8.30

The per ton value of the ore also recorded a considerable rise during that period. Compared to 1935, the pit-head value of the ore in 1958 was higher by five times. Though India's iron ore reserves are very large, yet its annual output, compared to some of the other ore producing countries of the world, is very small.

The chief iron ore producing countries of the world are: the U.S.A., the U.S.S.R., France, Sweden and Canada. Small production of ore comes from other sources like Venezuela, the U.K., Germany West, India, Luxembourg, Brazil, Spain, Austra-

lia, Peru, Chile, the Union of South Africa, Algeria, Siberia, Japan, Austria, Norway, Italy, Malaya, Philippines and a few other countries. TABLE No. 105, in the appendix, gives the output of iron ore, pig iron, ferroalloys and crude steel, from a few selected countries of the world, from 1947 to 1957.

Utilization

A major part of country's iron ore output is consumed in the production of iron and steel The first attempts in that direction was made in 1911 by Messrs Tata Iron and Steel Co., Ltd., at Jamshedpur, and since then the production of pig iron and steel has been continuously going on there. In 1921, Messrs Indian Iron and Steel Co., Ltd., started ore smelting at Asansol. In subsequent years, Messrs Mysore Iron and Steel Works went into operation at Bhadravati. Three more steel plants in the public sector, at Bhilai, Rourkela and Durgapur, are nearing completion while a scheme for the fourth plant at Bokaro is being matured.

In India, nearly 75 per cent of the pig iron output is directly taken over to steel production. The various types of steel alloys are of manganese, cobalt, nickel and chrome steels including ferromanganese and ferrochrome alloys. Iron and steel find wide applications in different industrial fields, building construction work, railways and ship-building industry, locomotives, and other miscellaneous engineering and mechanical products.

The growth of the steel industry in India can be visualised from the past records of steel production given in TABLE No. 47. A glance at the figures of world iron and steel production, given in the appendix, reveals India's relative position in the world steel Industry. Compared to the world steel production, India's target of 6.0 million tons to be achieved by the end of the Second Plan appears to be quite modest. But, considering country's own resources, it would be a great achievement, if the production target of 12.5 million tons of iron ore is attained by the end of the Second Plan, and that could be considered a land mark in India's history of mineral development. Even today the country is importing large quantity of iron and

TABLE NO. 47

Production of Crude Steel in India

Year	*Steel Ingots* (000) tons	*Year*	*Steel Ingots* Tons (000)
1935	628	1947	946
1936	664	1948	942
1937	680	1949	1012
1939	768	1950	970
1940	768	1951	1070
1940	961	1952	1118
1941	1070	1953	1030
1942	1011	1954	1239
1943	1930	1955	1260
1944	1025	1956	1338
1945	1003	1957	1347
1946	905	1958	1299

steel materials from foreign countries. In 1958, India imported iron and steel products worth Rs. 98 crores as against Rs. 148 crores in 1957.

Apart form the domestic consumption, a fair quantity of iron ore is being exported to countries like Japan, Czechoslovakia, Italy, Yugoslavia, Poland, Germany West, Germany East and Netherlands. In fact, India is earning a sizable foreign exchange from out of the iron ore exports. In recent years, country's iron ore exports have shown rising trends. TABLE No. 48 gives the iron ore exports from India from 1935-36 onwards.

India's position as a supplier of iron ore to the world market has improved a good deal in recent years. Japan has proved to be an expanding market for the Indian ore. Besides that Czechoslovakia, Poland, Hungary and certain other European countries have started buying more and more of the Indian ore.

Some times back India entered into an agreement with Japan for the supply of 7.3 million tons during the Second-Plan period. Her annual consumption of iron ore by 1966 is likely to be 10.2 million tons. Japan has also specified its requirements of ore beyond 1966.

State trading in iron ore was introduced in 1956 and from July 1957 the entire export trade in this commodity is being canalised through the State Trading Corporation. As a result of that, the private shippers and exporters in the country have started losing contacts with the foreign importers.

TABLE No. 48

Quantity and Value of Iron ore Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs	*Year*	*Quantity* Tons (000)	*Value* Rs. lakhs
1935-36	1.7	0.14	1947-48	—	—
1936-37	2.4	0.25	1948-49	—	—
1937-38	65.6	5.25	1949-50	4.3	1.23
1938-39	400.4	27.21	1950-51	84.5	22.21
1939-40	81.2	7.86	1951-52	280.0	99.96
1940-41	13.3	0.93	1952-53	810.0	370.47
1941-42	—	—	1953-54	1250.2	581.76
1942-43	—	—	1954-55	1008.9	421.13
1943-44	—	—	1955-56	1362.8	627.39
1944-45	—	—	1956-57	1792.6	931.30
1945-46	—	—	1957-58	2197.0	1185.32
1946-47	—	—	1958-59	1819.6	972.53

Today the iron ore mining industry has a number of problems, the solution of which can help in stepping up ore production. The problems of transport and shipping are perhaps the most acute ones in this particular case. India's competitive strength in the world market can improve considerably, if steps are taken to bring down the cost of ore production. For the purpose of exports, supply of ore can be arranged from areas around the coastal range. While the ore found in interior parts of the country can be reserved for domestic use.

With her vast reserves India can expand the volume of her iron ore exports manifold. There is a need for a comprehensive planning to organize the iron ore industry on sound lines.

KYANITE

Kyanite, andalusite and sillimanite, the natural products having similar chemical composition, possess a high thermal

resistance. Usually these are the silicates of aluminium but "Dumortierite" another mineral of the same type contains a little amount of boron. On calcination at 1500°C, kyanite is converted into another refractory product known as "Mullite." Mullite bricks stand a very high temperature.

Production

In India, the the kyanite deposits are found at Lapsa Buru in Kharswan in Bihar. The principal deposits, however, occur in Singhbhum district at Gadigidh between Badia and Bakra near Kanyaluka. In Seraikella, the kyanite deposits are found

TABLE NO. 49

Production of Kyanite in India

Year	*Quantity* Tons (000)	*Value* Total Rs. Lakhs	Average Per Ton Rs.
1935	21.3	3.76	17.6
1936	29.9	2.94	9.8
1937	40.1	10.01	24.9
1938	34.2	8.38	24.5
1939	14.0	2.89	20.6
1940	10.3	2.43	23.6
1941	14.9	3.34	22.4
1942	18.3	4.02	22.4
1943	15.3	3.40	22.2
1944	14.5	3.42	23.6
1945	17.5	4.45	26.1
1946	13.5	3.78	28.0
1947	14.4	5.99	41.6
1948	12.6	5.68	45.1
1949	19.9	15.23	76.5
1950	35.5	32.98	92.9
1951	42.5	58.57	137.8
1952	26.9	63.17	234.8
1953	15.4	23.66	153.6
1954	42.3	86.80	205.2
1955	11.7	16.70	142.2
1956	20.1	47.14	234.5
1957	23.5	54.68	232.5
1958	24.2	55.41	229.2

around Kukudungri and Jhar Gobindpur. Small deposits of kyanite are also known in Bhandara district of Bombay State and in Ajmer-Merwara in Rajasthan. Minor occurrences of kyanite are also reported in certain places in Madras and Mysore. Production activity in the kyanite industry is, at present, confined to certain places in Bihar. TABLE No. 49 gives the past output of kyanite in India since 1935.

Kyanite production showed considerable fluctuations in the past. The production activity in the industry is intimately linked with the foreign demand for kyanite. The varying demand for the mineral had been responsible for the fluctuations in output. The pit head value of the mineral also registered a big rise, the increase in value being fairly large in post-war years, particularly, during the First-Plan period.

Utilization

The quality of the Indian kaynite is quite superior, as in nature it is found in sufficiently pure form. The domestic consumption of kyanite is not very large, and most of it is exported to countries like the U.K., the U.S.A., Italy, France, Belgium, Germany West, Germany East, Denmark, Japan Formosa and Australia. TABLE No. 50 gives the quantity and value of kyanite exported from 1951-52 onwards. Separate figures for earlier years are not available.

TABLE No. 50.

Quantity and Value of Kyanite Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.	*Year*	*Quantity* Tons (000)	*Value* Rs. Lakhs
1951-52	22.59	49.25	1955-56	31.32	77.31
1952-53	21.62	68.09	1956-57	24.92	74.21
1953-54	15.17	37.96	1957-58	16.48	80.59
1954-55	24.31	59.44	1958-59	15.5	50.71

In India, the pottery, enamel and glass industries including bangle manufacture can make use of kyanite with a great advan-

tage. As India earns a fair amount of foreign exchange from out of the export of kyanite it is advisable to expand her export trade in that.

Kyanite industry needs a definite encouragement. With irregular production and uncertain marketing programme, the industry cannot operate economically. It is, however, necessary to undertake a market survey of this commodity, examining, particularly, the pattern of consumption of kyanite in foreign countries and that can help the producers to organize production of kyanite on a long term basis.

LEAD

Lead is usually found associated with metallic ores of zinc, silver or copper. Generally, the lead minerals are complex compounds; the common ore being the sulphide of lead, popularly, known as "Galena". Some times lead also occurs as a carbonate.

Notable deposits of lead-zinc ore are, however, found in Zawar mines in Rajasthan. The Zawar deposits, particularly, in the South of Udaipur extends to Mochia Mangra, Baror Mangra and Zawar Mala hills area and are of a considerable economic value. The ore reserves at Mochia Mangra are estimated at nearly 2.7 million tons; the low grade ore reserves being about 8 million tons.

India's lead ore production is hardly a fraction of the world's total output; the major lead ore producing countries of the world being, the U.S.A., Australia, the U.S.S.R., Mexico, Canada, Peru, Morocco and certain other countries. The U.S.A. alone is annually responsible for nearly one-fifth of the total lead produced in the world. TABLE No. 106 in the appendix, gives the lead ore and lead metal production from selected countries of the world in certain past years.

Utilization

Lead metal and its alloys find innumerable uses in industry and commerce. As a material of construction, lead is used to build reaction chambers and storage tanks for sulphuric acid

manufacture. In the form of sheets, pipes, pumping sets and tank lining, lead is extensively used in chemical industry. Lead is an important metal used in the production of plates for storage batteries. Its alloys find a number of uses in engineering industries. It is also a basic raw material for certain paints and pigments, like white lead, red lead, litharge, etc. Chromate of lead, in different shades, is a popular pigment employed in paint industry. Chemical compounds, like the acetate of lead and the basic acetate of lead, are of a considerable interest to the textile and sugar industries. Some of the organic compounds of lead also find certain industrial uses.

In India, lead is extracted from the lead-zinc ore, obtained from the Zawar mines of Rajasthan. From the 5.3 thousand tons of the lead concentrate produced in 1958, the metal recovered was about 3.33 thousand tons. TABLE No. 51 gives the production of lead metal in India since 1948.

TABLE No. 51

Production of Lead Metal in India

Year	*Quantity* (000) Tons	*Value* Rs. Lakhs
1948	0.54	7.05
1949	0.59	9.00
1950	0.63	8.58
1951	0.86	15.00
1952	1.13	17.38
1953	1.69	18.39
1954	1.79	23.08
1955	2.23	31.17
1956	2.50	37.58
1957	3.17	39.44
1958	3.33	28.89

The industry made rapid strides in the field of lead metal production in the course of about ten years. Though the production of lead in the country had shown rising trends in recent years, yet the quantity of metal extracted is not enough to meet the country's total requirements. Large quantity of

the metal is annually imported into India from places like Australia, Burma, China, Singapore, Yugoslavia and the U.K. TABLE No. 52 gives the quantity and value of lead imported into India since 1935-36.

TABLE No. 52

Quantity and Value of Lead imported into India

Year	*Quantity* Tons	*Value* Rs. lakhs.
1935-36	1686	5.73
1936-37	1314	5.37
1937-38	8693	31.89
1938-39	7937	21.47
1939-40	14052	45.76
1940-41	15927	60.75
1941-42	17498	71.87
1942-43	2181	16.93
1943-44	483	4.49
1944-45	917	4.53
1945-46	22284	100.11
1946-47	7515	47.17
1947-48	5345	68.84
1948-49	8349	116.74
1949-50	7405	111.63
1950-51	15692	221.6
1951-52	7726	172.14
1952-53	3350	65.56
1953-54	7423	96.07
1954-55	10176	142.23
1955-56	13272	207.94
1956-57	16668	275.51
1957-58	15709	217.01
1958-59	22732	241.26

In India the demand for lead metal had gone up considerably high, particularly during the First-Plan period. With increased industrial activity in the country, the demand for lead metal is likely to rise still further.

The question of developing indigenous resources of lead has

assumed a much greater importance in recent years. There is, however, a definite scope to organize better production from the Zawar Mines of Rajasthan. With improved conditions of supply, it may, perhaps, be possible to make the country self-sufficient in her requirements of lead after some years. For the present there is an urgent need to find out substitutes of lead.

LIME STONE

Limestone, the natural calcium carbonate, occurs as a mineralogical deposit in the form of a rock. The $CaCO_3$ contents of limestone range from 75 to 95 per cent. Besides that impurities like silica, magnesia, alumina and iron oxide are also present. Calcite and marble stone are the finer varieties of natural calcium carbonate.

Production

Limestone deposits are extensively found in almost all parts of the country. Vast occurrences of limestone are known in the

TABLE No. 53

Production of Limestone and Calcite in India

Year	*Limestone*		*Calcite*	
	Tons (000)	Rs.Lakhs	Tons (000)	Rs. lakhs
1945	3562	77.35	1.1	0.06
1946	5446	84.56	1.2	0.07
1947	3363	98.63	1.7	0.21
1948	3975	156.68	0.3	0.04
1949	4244	154.29	0.9	0.14
1950	4818	218.52	1.8	0.24
1951	5200	418.72	1.4	0.25
1952	4928	225.98	3.6	0.43
1953	6508	219.41	2.6	0.38
1954	6164	220.15	5.0	0.42
1955	7366	302.48	2.6	0.14
1956	8195	326.17	5.7	0.51
1957	9420	397.13	4.7	0.48
1958	10094	418.30	2.9	0.21

Shahabad, Japla, Hazaribagh, Ranchi, Singhbhum districts in Bihar; Bundi, Kotah, Pali, Sawiamadhopur and Sirohi, in Rajasthan; Kaira, Yeotmal and Porbandar (Kathiawar) in Bombay, Coimbatore, Salem, Tiruchirapalli, Tirunelveli in Madras; Satna, Jabalpur, Morena and Bilaspur in Madhya Pradesh; Patiala and Jind in the Punjab; Shimoga in Mysore; Jalpaiguri in Bengal (West); Adilabad, Anantapur and Guntur districts in Andhra Pradesh; and Dehradun and Mirzapur in U.P. Calcite deposits are located in Anantapur districts in Andhra Pradesh and Halar District (Saurashtra) in Bombay State, Hassan district in Mysore and Jaipur and Udaipur in Rajasthan. TABLE No. 53 gives the production of limestone and calcite, from 1945 onwards.

Both limestone and calcite production showed rising trends in the past; the expansion, during the First-Plan period was quite substantial.

Utilization

Limestone is the cheapest available building stone. It has also numerous commercial and industrial uses. Besides its use as a constructional material, it is largely used in the manufacture of lime, portland cements and lime mortars; all of these are the products of basic importance to the modern building science. In metallurgy, limestone is used as a flux, and is consumed in large quantity by the iron and steel industry. Limestone is extensively used in the sugar industry for juice purification purposes. Lime is also used in vegetable and edible refining industry. Lime and limestone are important ingredients used in glass and pottery manufacture. Limestone is also the basic raw material used in the production of bleaching powder and calcium carbide. In chemical industry, limestone is used in the manufacture of soda ash, caustic soda, and other similar products. Whiting, the softer variety of natural calcium carborate, is largely used as a filler in the paint and rubber industries. In the leather tanning industry, lime finds a substantial use. Both limestone and calcite find a number of other industrial uses. TABLE No. 54 gives the consumption of limestone and lime in some of the important industries in certain past years.

TABLE NO. 54

Consumption of Limestone and Lime by Important Industries

A. LIMESTONE

Tons (00)

Year	*Cement*	*Iron & Steel*	*Sugar*	*Glass*
1946	1219.0	699.3	37.5	3.3
1947	1563.8	738.8	42.4	2.7
1948	1584.2	686.0	78.4	3.0
1949	2107.1	786.0	66.9	2.6
1950	3114.0	792.5	70.9	3.3
1951	4024.8	883.9	130.9	3.5
1952	4413.4	894.3	95.6	3.7
1953	4766.9	742.0	92.5	4.1
1954	5497.7	934.4	245.7	5.0
1955	5531.7	915.0	192.5	5.3

B. LIME

Tons (000)

Year	*Sugar*	*Paper & Board*	*Tanning*	*Oil Industries*
1946	19.1	41.8	2.5	—
1947	14.5	28.0	2.5	—
1948	32.7	37.3	5.3	0.8
1949	16.2	37.6	8.4	0.36
1950	14.4	36.7	6.7	0.4
1951	17.0	46.3	11.0	0.35
1952	15.6	45.2	8.6	0.3
1953	11.5	46.5	10.1	0.25
1954	22.7	44.5	11.8	0.13
1955	20.3	57.0	10.8	0.01

The consumption of limestone in cement industry had gone up by four times in a period of 10 years while the consumption in the sugar industry was two and a half times higher. There was little change in the consumption by iron and steel and glass industries.

India has sufficiently large deposits of limestone and with her vast resources she can safely plan her various industrial and constructional projects. Limestone being a cheap and bulky

material, the problem of transport is the major handicap in the development of this industry.

LITHIUM

The natural ores of lithium are: 'spodumene', 'lepidolite' and amblygonite'—the first one being the lithium alumina silicate containing from 4 to 7 per cent lithia, the second, lithia mica and the third, lithium alumina fluophosphate.

In India, the lepidolite deposits are known to occur in the Bastar State, but those are not being exploited on account of its limited demand. The world's total production of lithia is also very meagre, not exceeding a few thousand tons annually. World's chief lithia producing countries are: the U.S.A., South West Africa, Australia, Sweden, Germany West, Argentina. Only a minor production of this mineral comes from countries like Canada, Spain, Portugal, and Southern Rhodesia.

Lithium increases the hardness, brightness and tensile strength of metals and is essentially used in electrochemical, electrical manufacturing and foundry industries. It is used in alloy industry. Potential uses of lithium compounds are in light metal alloys, food preservation, optical instruments, luminous pigments, etc. Lithium salts find an increasing use in glass and ceramic industries. Lithium compounds are also used as lubricants. Lithium chloride is used in storage batteries and dry cell batteries, in air conditioning industry and as a flux in welding workshops. Lithia water has a considerable medicinal value. Lithium chloride is also used in signal lights to produce a crimson flare.

Since lithium compounds are generally high cost materials, their utilization on a wider scale cannot be propagated. Even the recovery of lithium compounds is somewhat limited. Its utility is restricted to a few industries and to certain specific products. Its applications are sometimes of an academic value.

MAGNESITE & DOLOMITE

Magnesite is the natural magnesium carbonate, but when found associated with calcium carbonate, it is known as dolo-

mite. The $MgCO_3$ contents of magnesite are generally from 97 to 99 per cent.

Production

In India, the magnesite deposits are known in the Salem district of Madras and the Hassan district of Mysore. Certain deposits of magnesite are also reported in the Kurnool district of Andhra Pradesh, Tiruchirapalli district of Madras, Dungarpur in Rajasthan and Singhbhum district of Bihar. Recently, deposits of magnesite are also reported from Garhwal area in U.P. TABLE No. 55 gives the production of magnesite in India from 1935 onwards.

TABLE No. 55

Production of Magnesite in India

Year	Quantity Tons (000)	Value	
		Total Rs. Lakhs	Average Per Ton Rs.
1935	17.0	1.05	6.0
1936	15.5	1.02	6.6
1937	26.2	1.63	6.2
1938	25.6	1.61	6.3
1939	33.6	2.12	6.3
1940	43.3	2.77	6.4
1941	40.7	2.71	6.6
1942	47.8	3.23	6.8
1943	49.1	5.52	11.3
1944	41.9	5.25	12.5
1945	28.3	4.44	15.7
1946	44.7	6.10	13.6
1947	51.5	6.87	13.3
1948	48.3	6.61	13.9
1949	90.6	15.53	17.1
1950	52.9	10.87	20.5
1951	117.5	10.60	15.9
1952	89.0	16.18	18.2
1953	92.7	18.25	19.9
1954	70.5	14.53	20.1
1955	57.5	12.56	22.0
1956	91.7	18.46	20.1
1957	88.9	17.95	20.7
1958	99.0	16.50	16.7

The present world production of magnesite is of the order of 2 million tons per annum, of which 30 per cent comes from the U.S.A. The other producers of magnesite are: Austria, Yugoslavia, India, Greece, Australia, Spain, and the Union of South Africa. TABLE No. 107, in the appendix, gives the production of magnesite and magnesium from certain selected countries of the world from 1947 to 1957.

Utilization

Magnesite is mainly a refractory material used in the manufacture of bricks and as furnace lining for metallurgical operations. Magnesite on calcination gives a product which when mixed with asbestos yields a high class heat-insulating material used for lagging steam boilers, steam pipes and furnaces and for building light furnace tops. Magnesite also finds use in manufacture of magnesium sulphate, known as epsom salt, a product of great interest to the medical profession. Magnesium sulphate is, however, used for a number of other industrial purposes. Magnesite is also a raw material for producing metal magnesium, but the process of extraction has not yet been commercialized in India. In paint and rubber industries, magnesium carbonate finds use as a filler. Magnesium being a light weight metal has a great industrial and engineering importance. Alloyed with aluminium and zinc, magnesium is used in the aircraft industry. Magnesium alloys are used for producing engine parts and other miscellaneous equipment in aircrafts like the landing wheels, interior fittings, petrol and oil tanks and for the forged screws. Several parts of road transport vehicles are constructed out of magnesium alloys. Equipment like the machine tools, printing and textile machinery, electric motor casings, air-conditioning plants, telephone switch parts, optical instruments and busbars are also made of magnesium alloys. Magnesium powder and wire find use in explosives, flashlight powders and fireworks.

In India, magnesite is mainly consumed by the refractories, ceramics, iron and steel and paper and board industries. TABLE No. 56 gives the extent of past consumption of magnesite by some of the industries.

TABLE No. 56

Consumption of Magnesite by Important Industries

Quantity (000) Tons

Year	*Ceramics*	*Iron & Steel*	*Paper & Board*
1946	3.4	7.3	1.3
1947	3.1	7.7	0.9
1948	2.8	12.6	1.2
1949	3.3	14.2	1.2
1950	4.1	8.4	1.1
1951	..	8.1	1.3
1952	4.4	8.1	1.2
1953	5.5	8.4	1.2
1954	1.9	9.4	1.2
1955	4.7	8.5	1.2

A considerable quantity of magnesite is exported out of India every year to countries like the U.K., Japan, the U.S.A., Canada, Germany West, Netherlands, France, Chile, Australia and certain other places. TABLE No. 57 gives the exports of magnesite from India from 1935-36 onwards.

The exports of magnesite in 1958-59 were 7 times higher than those of 1935-36. There was a considerable appreciation in the value of the product exported during that period.

While India may be keen to expand her export markets in magnesite, the basic point that India is simultaneously importing large quantities of magnesium carbonate and magnesite bricks from abroad cannot be ignored. In 1958 India imported 873 tons of magnesium carbonate valued at Rs. 8.5 lakhs as against 1200 tons worth Rs. 12 lakhs in 1957. Nearly 1.6 million magnesite bricks valued at Rs. 68 lakhs were imported in 1958 as against 1.7 million bricks worth Rs. 72 lakhs in 1957. Considering the value of foreign exchange involved in the import of the two products mentioned above, it may perhaps be worthwhile to consider the possibility of producing magnesite bricks and also to examine the scope of producing chemically pure magnesium carbonate in the country. Prospects of extracting the magnesium metal from magnesite have yet to be explored in India. The

TABLE No. 57

Quantity and Value of Magnesite Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1935-36	3.94	4.20
1936-37	4.94	4.91
1937-38	8.53	8.34
1938-39	7.36	4.46
1939-40	11.64	9.22
1040-41	16.57	12.54
1941-42	14.23	7.76
1942-43	11.63	3.97
1943-44	12.51	7.05
1944-45	11.21	6.52
1945-46	3.47	3.24
1946-47	12.38	12.59
1947-48	11.27	13.67
1948-49	14.42	13.68
1949-50	10.19	8.02
1950-51	7.74	8.97
1951-52	13.35	14.48
1952-53	8.99	10.53
1953-54	4.95	6.54
1954-55	23.02	35.85
1955-56	26.95	41.68
1956-57	31.27	55.57
1957-58	19.31	32.79
1958-59	27.46	39.57

magnesite deposits of Salem district can be very usefully utilized for setting up a magnesium industry in the country.

DOLOMITE

Dolomite, the natural double carbonate of calcium and magnesium, is a widely distributed mineral. On calcination it yields a mixture of lime and magnesia which is a highly refractory material. Some of the dolomite occurrences yield remarkably pure products while at certain places dolomitic limestone is also found.

Dolomite deposits are known to occur in Orissa and Madhya Pradesh. In Orissa, the dolomite deposits of commercial interest

are found in Banposh and Birmitrapur in Sundergarh districts. Certain deposits are also known around Gangpur, Amghat, Khatkurbahal, Lanjiberna and Beldih. Dolomitic limestone deposits are found at Putada near Chaibasa in Singhbhum district. In Madhya Pradesh the dolomite deposits occur around Bhalaghat, Gwari, Rupaund in Jabalpur district and near Akaltara and Jairamnagar in Bilaspur. Other deposits of dolomite and dolomitic lime are found in Rajasthan, Andhra Pradesh, Mysore, Bombay, Kashmir, U.P. and the Punjab. TABLE No. 58 gives the output of dolomite in India from 1946 onwards.

TABLE No. 58

Production of Dolomite in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1946	72.7	2.30
1947	62.2	3.01
1948	82.1	3.60
1949	47.7	5.29
1950	53.0	6.56
1951	14.2	0.71
1952	54.5	8.80
1953	19.1	1.23
1954	137.8	15.18
1955	90.2	9.13
1956	96.5	15.34
1957	141.0	20.14
1958	166.6	22.81

Dolomite output recorded a substantial increase in recent years. Compared to 1951 the output in 1958 was nearly 12 times.

Dolomite finds extensive use as a refractory (basic) material and as a flux in the iron and steel industry. Other minor uses of dolomite are as a filler in the paint, rubber and textile industries. It is also used in cosmetics and disinfectant powders.

With the expansion of the iron and steel industry, the demand for dolomite has gone up in recent years. The development of the dolomite industry is in fact an integrated part of the expansion programme of the iron and steel industry in the country.

MANGANESE ORE

In nature, manganese ores are obtainable as a black mineral known as pyrolusite (MnO_2) and the psilomelane (the hydrated oxide), together with other black oxides, like the manganite, braunite, etc. The ore is graded according to its manganese contents; the first grade ore contains above 48 per cent manganese, the second grade being between 44-48 per cent, whereas the third grade contains 40-44 per cent.

Production

In India the manganese ore is found in Madhya Pradesh, Bombay, Orissa, Mysore, Andhra Pradesh, Rajasthan and Bihar. The ore production is, however, confined to Balaghat, Chindwara, Jabua, Jabalpur in Madhya Pradesh; Bhandara, Nagpur, Panch Mahal, Ratnagiri and Baroda in Bombay; Bolangir, Koraput, Keonjhar in Orissa; Belgaum, Bellary, Chitaldrug, North Kanara, Shimoga and Tumkur districts in Mysore; Sirkakulam, Vishakapatnam, and Cuddapah in Andhra Pradesh; Singhbhum district in Bihar; and Banswara, Kamalgarh and Udaipur in Rajasthan. India's estimated ore reserves are of the order 110 million tons. TABLE No. 59 gives the manganese ore output in India from 1935 onwards.

The important world deposits of manganese ore are located in the U.S.S.R., India, Ghana, the Union of South Africa, Cuba, Brazil, Belgian Congo, Egypt and Czechoslovakia. Small production of ore comes from other sources like Rumania, Mexico, Hungary, Turkey, Japan, Indonesia and other countries The U.S.S.R. has been the largest producer of manganese ore since 1929, although originally India held the first place in ore production. The average annual world production of manganese ore during the years 1934-38 was 4.86 million tons, whereas the

average during the years 1941-47 was nearly 4.40 million tons. In the year 1957 it was more than 10 million tons. TABLE No. 108, in the appendix, gives the world production of manganese ore from certain selected countries of the world from 1947 to 1957.

TABLE No. 59

Production of Manganese Ore in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1935	864.7	137.54
1936	742.6	136.48
1937	1151.8	470.31
1938	648.1	263.40
1939	781.1	164.18
1940	737.7	185.2
1941	568.9	183.17
1942	600.2	205.35
1943	712.4	238.18
1944	151.6	51.04
1945	171.3	57.81
1946	479.4	167.76
1947	451.0	96.41
1948	525.8	294.49
1949	646.0	445.62
1950	883.0	847.62
1951	1292.4	1783.47
1952	1462.3	2246.57
1953	1902.2	2948.47
1954	1413.1	1954.17
1955	1583.5	1081.54*
1956	1687.0	1297.57*
1957	1654.0	1405.58*
1958	1230.0	1123.96*

* Value estimated at pit-head cost but for earlier years it is based on the f.o.b. price.

Utilization

Manganese ore is one of the India's key minerals which finds an international market. The ore is largely used in the manufacture of steel as a deoxidiser and a desulphuriser and in the production of ferro-manganese alloys. Steel, with 1 per cent manganese content is used for structural purposes and for the production of rails. High manganese content steel, say, 12 per cent manganese, is used in the construction of equipment such as the mining equipment, rock crushers, etc. where high tensile strength and resistance to abrasion is required. In actual practice, the natural ore is not directly added to the furnace, but is introduced in the form of ferro-manganese alloy which contains nearly 80 per cent manganese, the rest being iron and carbon. Spiegeleisen, a ferro-alloy containing 20 per cent manganese prepared from the low grade ore is also used. On an average 10-14 lbs of manganese is used per ton of steel. In fact, about 90-95 per cent of the world manganese ore production is utilized in the manufacture of steel and alloys and the rest finds miscellaneous uses in the production of dry batteries and for other chemical purposes. Manganese dioxide acts as a depolariser in dry cells. Manganese dioxide of 80-85 per cent purity, free from iron is also used in ceramics and glass industry, while its inferior grades are consumed by the match and fire-work industries. In minor quantities it is used as driers in the ink and paint industry. Manganese dioxide, being a cheap oxidizing agent is an important chemical compound. In chemical industry, manganese dioxide is used as a raw material in the manufacture of potassium permanganate which is a powerful antiseptic and disinfectant, finding vast applications in hospitals and clinics. Manganese chloride and sulphate are also chemicals of great industrial interest. In the field of electro-deposition manganese plating has been successfully tried and that might find a commercial use.

In India, the manganese ore is used for the production of ferro-manganese and other alloys. The extent of ore consumption by the steel industry during the last ten years or so may be seen from the TABLE No. 60.

TABLE No. 60

Consumption of Manganese Ore by Steel Industry

Year	*Steel Produced* (000) tons	*Manganese ore consumed* (000) tons	*Per cent Consumption*
1946	905	54	5.97
1947	946	78	8.25
1948	942	52	5.52
1949	1012	79	7.81
1950	970	69	7.11
1951	1070	89	8.32
1952	1118	108	9.66
1953	1030	45	4.37
1954	1240	114	9.19
1955	1260	42	3.13
1956	1338	90	6.72

By the end of the Second Plan India has to attain an output of 160,000 tons of ferro-manganese of which 100,000 tons will be available for export. TABLE No. 61 gives the production of ferromanganese in India from 1935 onwards.

TABLE No. 61

Production of Ferromanganese in India.

Year	*Quantity* (000) Tons	*Year*	*Quantity* (000) Tons
1935	4.18	1947	15.77
1936	3.26	1948	9.14
1937	8.04	1949	16.47
1938	18.39	1950	15.05
1939	1.61	1951	23.41
1940	18.40	1952	11.45
1941	31.56	1953	3.10
1942	20.52	1954	36.71
1943	6.24	1955	12.00
1944	5.08	1956	24.00
1945	7.23	1957	4.56
1946	14.19	1958	44.28

The major portion of India's manganese ore output is exported to countries like, the U.S.A., the U.K., Germany West, Japan, Czechoslovakia, France, Italy, Norway, Sweden, Netherlands

and a number of other places. TABLE No. 62, gives the quantity and value of manganese ore exported from India since 1935-36. Ore exports showed rising trends in early post-war years but in recent years, the quantity of ore exported had come down. On the other hand the value of ore had gone up in certain years.

TABLE No. 62

Quantity and Value of Manganese Ore exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1935-36	729	132
1936-37	677	131
1937-38	1001	221
1938-39	456	107
1939-40	719	183
1940-41	510	147
1941-42	722	246
1942-43	577	191
1943-44	549	185
1944-45	157	53
1945-46	185	65
1946-47	462	184
1947-48	521	249
1948-49	309	181
1949-50	739	585
1950-51	821	801
1951-52	1125	1569
1952-53	1440	2176
1953-54	1568	2423
1954-55	990	1292
1955-56	920	1072
1956-57	840	1625
1957-58	1687	2971
1958-59	905	1361

From 1956 the State Trading Corporation stepped into the manganese ore export trade. It is understood that the Corporation, in a period of three years, has not been able to stabilize country's exports of manganese ore. In the light of the experience gained by the Corporation, there is a need for the revision of the country's export policy in respect of manganese ore.

Of the projected production of 2.0 million tons by the end of the Second Plan, nearly 75 per cent of the ore has to be exported. India is a potential supplier of ore to the foreign market but it has certain disadvantages. In recent years, the Indian ore has been facing competition in the international market. High cost of transportation and cargo freight are partly responsible for the uneconomic supplies. Further, the country's transport capacity has to be enlarged before the question of expanding ore exports is considered. A country-wise survey of markets abroad, if carried out periodically, would help a good deal in assessing the potential demand of foreign consumers of manganese ore. Based on that, the country may be able to plan its further production programme more effectively.

MERCURY

Mercury is also known as quick-silver. It mainly occurs as the sulphide ore known as cinabar.

Crimson grains of cinnabar have been noticed in the beach sand concentrates of Needakara near Quilon in Kerala state. Also a small occurrence of the ore is known near Sakoli in Bhandara district. Other minor occurrences of mercury ore have been reported in several parts of the country. There is at present no definite deposit of mercury ore worth exploitation.

The chief mercury producing countries of the world are: Italy, Spain, the U.S.A., Canada, Mexico, the Soviet Union, Yugoslavia, China and certain other countries. Nearly 60-65 per cent of the total world production of mercury comes from Italy and Spain, the rest from other countries. The production of mercury from 1947 to 1957 from a few selected countries of the world is given in TABLE No. 109 in the appendix.

Utilization

Mercury finds numerous uses in commerce and industry. The most important use, to which mercury is put, is in the production of scientific instruments such as thermometers, barometers, arc rectifiers, mercury vapour lamps and for electric contacts in different types of control devices. Metals like gold, silver

gams, and that particular technique is applied for refining some of these metals. Mercury is extensively used as cathode in the production of caustic soda, chlorine, hydrogen, acetic acid and acetone by electrotytic methods. Some of the chemical compounds of mercury find applications in the production of dry battery cells, antifouling compositions, paints and pigments, explosives, etc. Mercurous and mercuric chlorides possess a medicinal value and are used in the preparation of ointments and lotions for external application. Mercury salts are also used in industries like plastics, dyestuffs and chemicals. Country's requirements of mercury are at present satisfied through imports from foreign sources like Italy, Spain and the U.K. TABLE No. 63 gives the past imports of mercury into India since 1935-36.

TABLE No. 63

Quantity and Value of Mercury Imported into India

Year	*Quantity* (000) lbs.	*Value* Rs. Lakhs.
1935-36	421.0	9.22
1936-37	75.2	1.76
1937-38	225.9	5.94
1938-39	180.9	4.66
1939-40	197.6	8.53
1940-41	21.0	1.50
1941-42	60.90	5.58
1942-43	106.0	10.34
1943-44	54.6	5.26
1944-45	273.2	21.15
1945-46	177.2	11.53
1946-47	506.8	18.79
1947-48	328.2	10.26
1948-49	741.8	19.26
1949-50	134.5	4.87
1950-51	2846.0	97.74
1951-52	4.5	0.23
1952-53	2.6	0.34
1953-54	0.4	0.05
1954-55	..	0.01
1955-56	0.1	0.05
1956-57	373.0	56.05
1957-58	96.8	14.68
1958-59	166.9	23.80

The per unit value of mercury registered a considerable rise, particularly during war years, when supplies of the product were restricted. Practically, there was no import of mercury during the First Plan period, whereas with the beginning of the Second Plan the imports of the same were revived.

Apart from the import of mercury in a metallic form, a number of mercury salts like the mercuric chloride, mercurous chloride, mercury ammonium chloride, mercury oxide, etc. are imported into the country every year. In 1958 India imported nearly 19 thousand pounds of mercury salts valued at Rs. 2.2 lakhs as against 26 thousand pounds worth 4.0 lakhs in 1957. The imports mainly came from the U.K. China, the U.S.A., France and Germany West.

For mercury and its compounds, India has to depend on foreign sources for a considerable time to come. There is an urgent need to restrict the consumption of mercury in the country as far as possible. Drastic economy measures are recommended in its use. There is, in fact, a vital need to consider the scope of finding out the substitutes of mercury and to minimize the wastage of the metal wherever it is being used.

MICA

Mica, the complex silicate of potassium, aluminium and magnesium, occurs in various natural forms. Muscovite, phlogopite, biotite, vermiculite and lepidolite are some of the common products belonging to the mica group of minerals. For commercial use generally the muscovite and phlogopite are in demand. Mica occurs as pegmatite veins associated with minerals like feldspar and quartz. Beryl, the beryllium ore, is obtained as a by-product in the mica mining operations.

Production

In mica mining, India ranks as the first country of the world. In fact, the world's 80 per cent demand for sheet mica is satisfied by the Indian product. In India the mica deposits are known to occur in the districts of Gaya, Hazaribagh and Monghyr in Bihar, the Nellor district in Andhra Pradesh and the Nilgiri dis-

trict in Madras. Mica deposits are also located around Ajmer, Bhilwara, Jaipur and Udaipur in Rajasthan, Balaghat in Madhya Pradesh, and the Hassan district in Mysore.

Crude mineral is cut into slabs of certain thickness and from that, blocks of desirable size and dimensions are sorted out, rejecting the defective ones. Mica splittings of a fraction of an inch thickness are also prepared and bundled together for marketing. Waste and scrap mica is also produced in the mining operations and during the process of dressing the crude mica.

In earlier years the mine output was not accurately recorded. No reliance can be placed on published data, as the annual figures of exports of different varieties of mica were in much excess of the reported output during those years. That point seems to have been rectified from 1955 onwards. TABLE No. 64, gives the quantity and value of the crude mica produced from 1955 to 1958.

TABLE No. 64

Production of Crude Mica in India

Year	*Quantity* (000) cwts.	*Value* Rs. Lakhs.
1955	465	295.70
1956	561	356.02
1957	609	231.54
1958	626	251.38

India is the world's largest producer of block mica and splittings, while a small production also comes from countries like the U.S.A., Argentina, Madagascar, Southern Rhodesia and Tanganyika. Scrap and waste mica is produced by the U.S.A. in large quantity. World output of mica from a few selected countries in certain past years is given in the TABLE No. 110 in the appendix

Utilization

Because of its high insulating properties, mica finds vast applications in the electrical industry. In wireless industry mica

is indispensable in the production of condensers and radio tubes. Mica splittings with certain bonding agents are used to produce other insulating materials like the micanite board, micanite cloth and micanite paper. Finely powdered mica scrap is used in the production of roofing wall paper and paints. It is also used as a filler in automobile tyres, moulded insulators and rubber goods. Mica is also used as a lubricant.

In India there is very little domestic consumption of mica. It is mainly an export commodity from which India earns a sizable foreign exchange. The U.S.A. is the principal export market for the Indian mica. Export of mica is also being made to the U.K., West Germany, Japan, Sweden, Poland, Denmark, Netherlands, Belgium, France, Czechoslovakia, Italy, Yugoslavia, Hungary, Austria, Singapore, Hong Kong, Mexico, Chile and other countries. In India the principal mica markets are Kodarma and Giridih in Bihar, Calcutta and Madras. TABLE No. 65 gives the exports of mica blocks, splittings and waste from India from 1935-36 onwards.

Compared to the earlier years, the exports of mica during post-war period were substantially high. On value basis, the year 1951-52 was a period of peak export, while the quantity of mica exported was larger in subsequent years. From the fluc tuating export figures of mica blocks and splittings, it is quite apparent, that the foreign demand for these products had never been stabilized in the past.

India has vast reserves of mica and is undoubtedly a potential source of supply of this commodity to the world market. The production activity in the mica industry is in fact dependant on its marketing programme. The unstable character of the industry had also been linked with its uncertain employment programme. The speculative trends in the markets have further aggravated the condition of the industry. Realizing the absence of a proper marketing organization, the Government of India in 1956 with the help of the industry, was able to set up the Mica Export Promotion Council. Efforts have yet to be made to improve the condition of the industry. Lack of coordination between the foreign consumers and the Indian producers of mica seem to be the basic reason for the uncertain

TABLE NO. 65

Quantity & Value of Mica Exported from India

Year	Total		Block		Splittings		Waste or Scrap*	
	Quantity cwts	Value Rs. lakhs	Quantity cwts	Value Rs. lakhs	Quantity cwts	Value Rs. lakhs	Quantity cwts	Value Rs. lakhs
1935-36	166649	83.49	24528	41.65	142121	41.84	—	—
1936-37	179594	94.06	27301	47.10	152293	46.96	—	—
1937-38	293971	148.40	27576	56.36	266395	92.04	—	—
1938-39	161846	114.12	22228	46.56	139616	67.56	—	—
1939-40	218936	176.86	29549	76.69	113166	98.28	76211	1.90
1940-41	139090	147.38	15124	52.79	94760	93.78	29215	0.81
1941-42	241043	305.41	27183	100.15	201882	204.90	11978	0.36
1942-43	190851	271.16	34726	117.39	135966	150.80	20159	2.97
1943-44	149650	280.40	40401	127.23	69814	152.31	39435	0.87
1944-45	76734	294.43	25446	133.43	46288	160.90	5000	0.11
1945-46	125031	245.39	25192	144.68	81146	100.12	18693	0.58

1946-47	185278	300.09	21858	98.23	127546	200.62	35876	1.24
1947-48	255259	656.14	14937	128.02	174870	433.51	65452	3.60
1948-49	340257	593.74	12134	83.65	200174	502.85	127949	7.24
1949-50	297726	684.58	8827	95.23	207524	584.03	81375	5.33
1950-51	406705	1000.46	21248	189.22	248440	803.25	137017	7.99
1951-52	407666	1320.94	32778	439.58	203503	871.54	144385	9.81
1952-53	284102	901.17	27882	405.51	101252	486.07	154968	9.18
1953-54	254738	799.71	34065	429.48	106260	363.88	114413	6.34
1954-55	373804	672.39	35300	368.03	108204	292.81	229300	11.55
1955-56	519301	837.12	105120	476.41	148878	347.60	265303	13.12
1956-57	410576	876.77	48102	461.31	137434	403.67	225040	11.79
1957-58	425427	865.30	44868	380.91	143143	472.78	237416	11.61
1958-59	396451	965.95	48732	512.87	121371	441.36	226348	11.72

* Separately recorded from 1939-40.

growth and development of the mica industry in India. The question of producing synthetic substitutes of the natural product are also afoot in some of the foreign countries and that holds a regular threat to the mica marketing programme of the country.

MOLYBDENUM

Molybdenum generally occurs as sulphide known as molybdenite. It also occurs as complex mineral containing tungsten and calcium and also as lead molybdate.

In India molybdenum is found in several places, particularly in the Hazaribagh district near Mahabagh at Baragunda. Certain deposits are also known to occur in the Khasi Hills around Cherrapunji in Assam and also at Kumavaram and other places in Godavari district in Andhra Pradesh. Minor occurrence of molybdenum is also reported in certain places in Madras, Kerala and Rajasthan. There is, however, no production of molybdenum or its minerals in the country.

More than 90 per cent of the world's production of molybdenum comes from the U.S.A. Other producer of molybdenum are Chile, Yugoslavia, Canada, Norway, Mexico, Japan and certain other countries. TABLE No. 111 in the appendix gives the output of molybdenum from certain selected countries of the world. in certain past years.

Molybdenum is chiefly used in the steel industry, a certain amount of it is used in cast iron and malleable castings. As pure metal, molybdenum is used in electronic industry. Some of the molybdenum compounds find use in the pigment and ceramic industries.

Since Molybdenum is a metal of strategic importance the question of prospecting indigenous deposits is really of great importance. Promising results can, however, be expected from some of the deposits located in Bihar. At the same time, a good deal of work has to be done to acquire the technological perfection in the process of metal extraction from the ores.

NICKEL

Nickel minerals generally occur as complex sulphides or as silicates found in the form of veins.

Nickel ore deposits are not much known in India but a small quantity of nickel is being recovered from copper ore smelting of the Indian Copper Corporation at Ghatsila. In small quantity, nickel is found in the copper deposits of Khetri near Jaipur in Rajasthan. A small quantity of nickel is also reported from Nepal.

World's supplies of nickle mainly come from Canada and nearly three-fourths of the total world demand is satisfied by that country. Other nickel producing countries of the world are: New Caledonia, Cuba, the U.S.A., the Union of South Africa, Finland, the U.S.S.R., Norway, Burma, Poland and Japan. The average annual world production of nickel in recent years was a little less than 0.3 million tons. TABLE No. 112, in the appendix, gives the production from the principal nickel ore producing countries of the world in certain past years.

Nickel metal is mainly used in the manufacture of steel alloys *viz.*, stainless steel, chrome-nickel steel, monel metal, etc. Nickel alloys are extremely useful as materials of construction for equipment used in chemical and other allied industries. The commercial uses of stainless steel and monel metal are too numerous to be recorded here. Stainless steel is particularly used for producing containers and utensils for domestic use. Cutlery and surgical instruments, manufactured out of stainless steel, are quite popular. Nickel metal and nickel salts, like the sulphate, the double sulphate, the carbonate and the chloride and some of the patent salts used in the electroplating indnstry are generally in big demand. A thin layer of electrolytically deposited nickel gives rust-proof surface to articles made of iron, copper and brass, which are otherwise less resistant to corrosion caused by the action of atmospheric moisture and air. Nickel is used, as a catalyst, in the hydrogenation process of fats and oils.

In India nickel metal is exclusively imported and supplies are mainly obtained from the U.K., Canada, the U.S.A. and cer-

tain other countries. TABLE No. 66 gives the quantity and value of the nickel imported into India in certain past years.

TABLE No. 66

Quantity and Value of Nickel Imported into India

Year	Cwts (000)	Rs. Lakhs
1953-54	7.5	17.61
1954-55	7.7	23.69
1955-56	3.1	13.07
1956-57	7.1	25.72
1957-58	17.8	83.12
1958-59	13.2	69.90

As indigenous resources of nickel are poor, the consumption of the metal in the country should be restricted as far as possible. At the same time efforts should be made to locate more ore reserves if possible. There is also an urgent need to find out the substitutes of nickel.

OCHRES

In India, ochres and mineral pigments are found in different grades and shades. Classified as coloured clays or earths, these pigments generally owe their colour to the oxides of iron which are usually present in anhydrous or hydrated form. Ochres are graded according to their colour, such as yellow ochres, red ochres, red oxides of iron, umbers, siennas, etc.

Production

Natural ochres and pigment colours are plentifully and cheaply available in all parts of the country. Ochres belong to a softer variety of minerals like the clays, hence these can be raised quite cheaply. Inferior grade of ochres need washing and refining to eliminate grit and other impurities. In India the production of ochres and mineral pigments in the past has been irregular, as is evident from the TABLE No. 67.

TABLE NO. 67

Production of Ochres in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1936	6.4	0.37
1935	8.2	0.41
1937	6.6	0.34
1938	5.7	0.33
1939	7.2	0.49
1940	10.4	0.53
1941	11.4	0.59
1942	14.1	0.68
1943	6.4	1.12
1944	12.2	1.56
1945	10.3	2.64
1946	8.7	1.72
1947	11.4	2.00
1948	10.6	2.87
1949	6.0	1.14
1950	12.0	1.81
1951	11.3	1.34
1952	17.6	3.05
1953	59.6	2.81
1954	75.5	5.47
1955	16.2	2.72
1956	12.6	2.70
1957	15.6	3.36
1958	17.9	3.54

From the wide fluctuations in output of ochres in the past, it is quite apparent that the industry is not properly organized. Irregular demand for ochres appears to be the main reason for the unsteady character of the industry.

Utilization

Ochres and pigments find a considerable use in the paint industry. These are also used as fillers and cheap colouring

agents in rubber and card-board industries. Some of these pigments are used in the production of special cements. Ochres are also to a certain extent used in coloured pottery, but on account of the advancement in the modern white pottery, the coloured products have lost popularity with consumers. Cheap paints, in different shades and colours, such as yellow (light, medium and dark); green (light, medium, dark); dull and bright red, brown, chocolate are produced out of these natural ochres. Blue and orange colours in different shades are obtained by making suitable combinations.

India is self-sufficient in her supply of ochres and mineral pigments as these are found in great abundance in different parts of the country. Prospects for the expansion of the paint industry in India appear to be quite bright as mineral pigments and vegetable oils, the basic raw materials needed for that are plentifully available. The condition of the industry can improve further if care is taken to produce minerals of standard specifications. The industry needs a definite encouragement.

PETROLEUM (Crude Oil)

The formation of mineral oils under the natural rocks is a matter of geological gestures. Several theories have been propounded to explain the existence of the crude oil in the earth's crust.

With the separation of Burma in 1937, and, after the partition of the country in 1947, India's petroleum resources have become quite limited. In India oil fields have been located in Cachar and Lakhimpur area in Assam. In recent years oil-wells have been drilled in areas around Nahorkatyia and Moran. Oil prospecting is, however, being carried out at several places in the country. Places where experimental drilling to prove the existence of oil is in progress are Jawalamukhi and Hoshiarpur in the Punjab, Cambay and Baroda in the Western region of the country. Oil prospecting is also being carried out in certain regions of West Bengal and a few other places in the country.

India's output of crude oil is hardly a fraction of the total world output. Other large-scale oil producing countries

of the world are: the U.S.A., the U.S.S.R., Venezuela, Saudi Arabia, Kuwait, Iraq, Iran, Rumania, Indonesia, Columbia, Argentina, Canada and Mexico. TABLE No. 113, in the appendix, gives the crude oil output from selected countries of the world in certain past years.

Crude oil is a product of international interest. In fact, the petroleum products are evaluated like coal and electricity, where the problem of fuel and energy supply has to be tackled. The present achievements in the sphere of transport are entirely due to the various petroleum products like the motor and aviation spirits, kerosene and other middle oils, used for traction, lighting and fuel purposes. Diesel oil is also a product of great industrial and engineering interest. Paraffin wax, a product of the petroleum industry, is used for candle manufacture. Greases and lubricants, the other petroleum products, are used to improve the working efficiency of machinery and mechanical equipment.

The fractional distillation of crude oil yields light oils, medium oils and heavy oils, which fall in the categories of motor spirits, kerosene and lubricating oils. The residues are mainly waxes and asphaltic base. By the process of cracking (heat treatment under pressure) of crude oil, it is possible to obtain motor spirit and aviation spirit, which are the key to automobile and aircraft industries.

In India the oil refining is being carried out at Digboi in Assam. Three oil refineries, operating on imported crude oil, have recently been set up, two at Trombay (Bombay) and one at Vishakapatnam. Two more oil refineries, one in Assam and the other in Bihar, are also planned to be set up shortly.

In recent years there has been a considerable rise in the country's requirements of crude oil and petroleum products. India imports annually large quantities of mineral oil products including crude oil from foreign countries. Crude oil is mainly imported from Saudi Arabia, Kuwait, Iraq, Iran, Indonesia and certain other countries. For finished products, the country has to depend on the U.S.A., the U.K., and some of the Middle East countries. In 1958 India imported petroleum products

worth Rs. 60.30 crores as against Rs. 77.76 crores in 1957. The crude oil imports into the country were worth nearly Rs. 15.54 crores in 1958 and Rs. 29.75 crores in 1957.

Recently, the Government of India have chalked out an elaborate programme to undertake exploration and drilling and refining of oil in the public sector. To implement its oil policy, the Government had set up the Oil and Natural Gas Commission in 1956. With certain new oil findings at one or two places there is some hope of improving the country's oil reserves. The question of intensifying search for oil has become imminent. The Government must make adequate financial provisions for undertaking this colossal job.

PHOSPHATES

Phosphates occur in nature in two forms, viz. the rock or mineral phosphate and the animal phosphate; both of which are mainly the phosphates of calcium. The occurrence of mineral phosphates in earth's crust is attributed to the formation of calcium phosphate in sea-beds under marine conditions, which appeared as geological beds after metamorphic changes took place in the earth's planet. Rock phosphate occurring veins and nodules are usually the refuse of birds founds as regular deposits through ages. Phosphates also occur as nodules associated with sedimentary rocks.

Production

Apatite, the phosphate of calcium, also sometimes contains a small quantity of fluorine and chlorine. Apatite deposits containing about 20 to 25 per cent P_2O_5, occur associated with mica-bearing pegmetite of Hazaribagh in Bihar. Deposits are also concentrated around Nandup, Patharghara, Badia and Sungri areas in the Singhbhum district. Other phosphate deposits are known in the Mayurbhunj district of Orissa and Srikakulam district of Andhra Pradesh. Desposits of phosphate nodules are also known in Tiruchirapalli district of Madras. Minor occurrences of phosphates are also reported in Bombay and certain other States. The phosphate production is at present confined

to certain regions in Bihar and Madras. TABLE No. 68 gives the past output of apatite in India from 1935 onward.

TABLE No. 68

Production of Apatite in India.

Year	*Quantity* Tons (000)	*Value* Rs. (000)
1935	0.10	1.5
1936	0.13	1.3
1937	0.17	1.7
1938	0.02	0.1
1939	0.18	0.9
1940	0.12	0.6
1941	0.08	0.9
1942	0.33	4.3
1943	1.20	15.3
1944	0.23	2.3
1945	0.52	5.2
1946	0.24	2.4
1947	0.85	8.5
1948	1.11	15.4
1949	0.60	8.5
1950	3.00	37.0
1951	0.42	6.4
1952	0.45	6.9
1953	4.36	42.0
1954	2.29	38.0
1955	5.56	83.0
1956	8.79	132.0
1957	9.18	190.0
1958	14.57	362.0

Prior to 1947 the apatite production in India was small and irregular. Generally the output of the industry showed rising trends in earlier years. But it was from 1953 that the industry's contributions in the field of production were quite marked. Com-

pared to 1951 the production of apatite in 1958 had gone up manifold.

World's chief producers of rock phosphates are the U.S.A., Morocco, Tunisia, Nauru Island, Egypt, Algeria, and the U.S.S.R. Other countries producing phosphates in small quantity are: Christmas Island, Ocean Islands, French Oceania, Netherlands Antilles, France and certain other countries. TABLE No. 114 in the appendix gives the output of rock phosphates from some selected countries of the world from 1947 to 1957.

Utilization

Phosphates find extensive use as fertilizer. Usually the insoluble calcium phosphate on conversion into superphosphate is rendered easily available to the plant life. Apart from that, the phosphates are used in metallurgy and are also the important source for phosphoric acid and other phosphates. Phosphorus, in elemental form, is also recovered from some of these compounds, particularly, the phosphorous pentoxide and pentachloride which are also obtained from the phophates.

In India the apatite is utilized for agricultural purposes. The present output of the industry is inadequate and hardly meets a fraction of the country's total requirements. For domestic consumtion quite a large quantity of natural rock phosphates is annually imported into India from countries like Jordan, Egypt, France, Morocco and certain other countries. In 1958 India imported roughly 125 thousand tons of rock phosphates valued at nearly Rs. 12 lakhs, as against 116 tons valued at Rs. 15.5 lakhs in 1957. For use in the iron and steel industry there is a substantial demand for phosphates. Phophorus needed for the match industry and for defence purposes can also be extracted from some of these phosphates.

India's resources of natural phosphates are poor. Phosphates of animal origin are also utilized at an increasing scale for agricultural purposes. Unless new deposits of mineral phosphates are found out it may not be possible to keep high hopes regarding the supply of phosphate fertilizers from domestic sources.

POTASH SALTS

Of the various known potash salts, saltpetre is an important commercial product, which is chemically the nitrate of potash, and was once being produced in India in large quantities. Potassium chloride and potash feldspar are also the products of commercial interest. The associated impurities in saltpetre are generally the chlorides of sodium and potassium. The commercial grade of saltpetre is 90 to 95 per cent pure, while the higher grades contain 99 per cent potash nitrate with 0.25 to 1.00 per cent chlorides.

Saltpetre is extracted mainly from the surface soils obtained from certain tracts of land unfit for agricultural production. Such isolated sites are located in the States of Uttar Pradesh, Bihar, Madras, Madhya Pradesh, the Punjab and Orissa. The various centres of production are in the districts of Gaya, Muzzaffarpur, Saran and Champaran in Bihar; the districts of Allahabad, Banaras, Kanpur and Ghaziapur in Uttar Pradesh; Coimbatore, Krishna, Madurai, Salem, Tiruchirapalli, and Nellor in South; and Bhind in Jawahargarh area in Madhya Pradesh.

In early years the annual saltpetre production in undivided India was of the order of 20,000 tons, but the industry received a great set back, after the first world war, when it faced competition from the Chilean saltpetre. The deterioration of the indigenous industry continued, till the time when the second world war broke out. Saltpetre was again in demand for the manufacture of chemicals and for explosive purposes. In the absence of authentic data on production, it may be difficult to visualise a true picture of the saltpetre industry in India. TABLE No. 115 in the appendix gives the output of potash salts from selected countries of the world in certain past years.

Saltpetre finds numerous uses in the industry, the most important one being in the manufacture of explosives. In the manufacture of sulphuric acid, the oxides of nitrogen obtained from the nitrate, oxidise the sulpur dioxide into trioxide. Saltpetre can be used in place of Chilean saltpetre but in cost it does not compete favourably. Saltpetre is the basic raw material needed for the manufacture of nitric acid and other nitrates. Some of the

potash salts like the carbonate, permanganate and hydroxide of potssium are also manufactured from the saltpetre. In glass and ceramic industries, the saltpetre is use das an important ingredient. For certain types of crops, saltpetre is an effective fertilizer, providing both the potash and the nitrate constituents.

In earlier years a major part of country's output of saltpetre was exported out of India, but of late the export of this commodity has been restricted. Though the output of the industry is irregular and unsteady, there is an ample scope to organize this industry on sound lines. As the demand for potash salts in the country is gradually going up, it is quite desirable to exploit as far as possible, the country's own resources of potash salts.

SILICA

Chemically the silica is known as silicon dioxide. In nature, the silicon is found in great abundance as silica anl certain complex silicates. Sand, quartz stone and quartzite are the common forms of silica and are found plentifully in all parts of the world. Usually, quartzite occurs as a rock and is found in river-beds, sea-beds and practically everywhere.

Ordinary sand is found in abundance in all parts of the country, but the glass makers' sand is somewhat scarce. Deposits of white sand are known in Loghra and Bargarh in U.P., Sawai Madhopur in Rajasthan, Jaijon in the Punjab and in Mangal Hat and Pathrasghatta in Bihar, and also in a few places in South India. As production of sand and quartz is not organized into a regular industry, authentic data regarding production etc. is not available. The white sand usually needs washing if a finer quality of the same is needed.

Ordinary sand is largely consumed for building and constructional purposes. Sand also finds use in foundries for moulding purposes. Silica, as a refractory material, is used in steel smelting furnaces. White stand, free from iron, is largely used in glass, pottery and ceramic industries. Sand is also used as an abrasive. Quartz is largely used in the manufacture of stoneware pottery and refractory bricks. Sands are generally graded according to their utility. Sand, free from mud and silt, is used

in building construction work, but for other industrial purposes the undermentioned features are taken into account:

Grades of Sand	*Important features*
1. Building sand:	Clear, sharp and angular sand, free from silt and mud.
2. Moulding sand:	Cohesiveness, refractory, moulds sufficiently, permeable to permit escape of gases.
3. Filter sand:	Free from clay and organic matter, evenly sized grain.
4. Abrasive sand:	Grain round or angular, but size uniform.
5. Glass sand:	Grain uniform size; white and free from iron (limit for colourless batch up to 0.02 per cent of iron).

In India the quartz and white sand are chiefly consumed by the ceramic and blass industries. The extent of their consumption by the organised sector of the industry, in cerptain past years, may be seen from the TABLE No. 69.

TABLE No. 69

Consumption of Quartz and Silica by Selected Industries.

(000) Tons.

Year	*Silica*		Quartz
	Glass & Glass-ware	Ceramics	Ceramics
1947	9.2	0.78	32
1948	29.3	0.85	36
1949	29.5	0.49	38
1950	30.8	0.33	41
1951	25.8	0.38	42
1952	34.0	0.19	43
1953	42.4	0.21	52
1954	62.9	0.27	35
1955	69.1	0.17	44

The consumption of sand and quartz is rapidly going up in India. With further expansion of the glass, ceramics and refractory industries, the country's consumption of these minerals is likely to increase enormously. In fact, the sand requirements of the glass industry by 1960-61 are expected to be nearly 2,00,000 tons. The main problem is to procure a proper quality of sand. Large scale glass factories can have sand washing facilities, but for small manufacturers the supply of washed and properly graded sand can be ensured, if arrangements are made to upgrade the sand at the pit-head. For some of the manufactured products of silica, like silica and silicon carbide bricks, the country has to depend on foreign sources of supply. In 1958 India imported 2.9 million silica bricks valued at Rs. 82 lakhs, from the U.K., Germany West, Netherlands, Belgium, Japan and the U.S.A., as against 5.2 millions worth of Rs. 121 lakhs in 1957. Silicon carbide bricks worth Rs. 4.7 lakhs were imported in 1957, while in 1958 the imports were worth only Rs. 0.7 lakhs.

India's resources of silica and quartz can be considered quite sufficient to meet country's domestic demand. There is a considerable scope for stepping up the production of silica refractories in the country. The production of fused silica equipment which is at present imported from foreign quarters, can also be attempted in India. For that the question of acquiring technical perfection is very essential. The production of glass makers' sand should also be organized on proper lines so as to ensure the supply of good quality sand at a cheap cost to the industry.

SILLIMANITE

Sillimanite is a natural silicate of aluminium and is similar to kyanite in composition and properties. It possesses a high thermal resistance.

Production

In India sillimanite deposits are known to occur in Khasi Hills in Assam, in Rewa and Bastar in Madhya Pradesh. Deposits in Assam are particularly concentrated around Sona Pahar, Nongpar and Nangbain villages. Deposits of sillimanite are also

reported in the Kerala and Mysore states. TABLE No. 70 below gives the production of sillimanite in India from 1936 onwards.

TABLE No. 70

Production of Sillimanite in India

Year	*Quantity* (000) Tons	*Value* (000) Rs.
1936	0.14	1.84
1937	..	..
1938	0.16	2.17
1939	..	..
1940	0.22	2.95
1941	0.20	2.72
1942	0.34	3.13
1943	0.24	3.25
1944	0.04	0.55
1945	0.03	0.41
1946	0.07	0.88
1947	0.07	0.28
1948	0.21	16.00
1949	0.97	73.97
1950	1.48	110.05
1951	4.05	198.00
1952	5.08	376.00
1953	5.49	465.00
1954	3.07	151.00
1955	2.42	123.00
1956	4.64	234.00
1957	7.42	444.00
1958	13.85	784.00

It was only during the First Plan period that production of sillamanite started showing definite trends, as earlier to that the industry operated on a minor scale. The pit-head value of sillimanite also registered rising trends in post-war years.

Utilization

Sillimanite being a highly refractory meterial, finds extensive applications in high temperature industries. The glass industry particularly finds sillimanite blocks very suitable for furnace lining. Sillimanite has certain definite advantages over kyanite which is used for similar purposes.

A fair proportion of the sillimanite production is exported out of India every year to countries like Germany, Belgium, France, Italy, Japan, Thailand, Netherlands and the U.K. TABLE No. 71 gives the quantity and value of sillimanite exported out of India beginning from 1951-52.

TABLE NO. 71

Quantity & Value of Sillimanite Exported from India

Year	Quantity (000) Tons	Value Rs. Lakhs
1951-52	3.29	9.58
1952-53	3.71	12.78
1953-54	2.53	8.68
1954-55	2.66	8.82
1955-56	5.17	16.32
1956-57	4.91	14.98
1957-58	6.04	19.47
1958-59	8.63	28.59

Domestic consumption of sillimanite is also gradually going up. With rising demand for sillimanite from foreign and domestic quarters, the prospects of expansion of the sillimanite industry in the country have improved considerably. The industry needs a definite encouragement.

SILVER

Silver being a precious element like gold is a metal of great importance. Silver is generally obtained as a by-product from the gold and copper refineries, as it is sometimes found associated with ores of lead, copper, gold, etc. In natural form it is found as a sulphide.

Production

In India silver is recovered from the gold refining operations in the Kolar Gold Mines of Mysore and from the Hutti mines of Andhra Pradesh. From the Zawar lead-zinc mines of Rajasthan a small quantity of silver is also reported. TABLE No. 72 gives the silver production in India from 1935 onwards.

TABLE No. 72

Production of Silver in India

Year	Quntity ounces (000)	Value Rs. Lakhs
1935	24.48	0.39
1936	25.35	0.34
1937	24.64	0.32
1938	22.30	0.30
1939	22.75	0.33
1940	23.30	0.38
1941	22.93	0.42
1942	20.10	0.49
1943	18.61	0.49
1944	14.24	0.48
1945	14.15	0.49
1946	9.82	0.41
1947	12.42	0.55
1948	12.80	0.60
1949	11.28	0.53
1950	15.68	0.68
1951	14.61	0.70
1952	17.68	0.74
1953	14.62	0.62
1954	161.19	6.68
1955	153.94	5.73
1956	105.00	4.38
1957	126.00	6.05
1958	110.00	5.48

In earlier years the silver output recorded a falling trend till it touched a very low level in 1946. After that the production trends were in the upward direction. Abnormally high production was reported in 1954, therafter it again started coming down.

World's chief silver producing countries are: Mexico, the U.S.A., Peru, Canada, Australia and Bolivia. Relatively lesser production comes from Belgian Congo, Japan, Yugoslavia, Sweden, Chile, Morocco, the Union of South Africa, Honduras, Argentina, South West Africa, France and Italy. TABLE No. 117, in the appendix, gives production of silver from certain selected countries of the world. Of the total world output of 6 thousands tons of silver in 1957, more than 70 per cent came from Mexico, the U.S.A., Peru and Canada and the rest of 30 per cent came from other parts of the world.

Utilization

Like gold, silver was once a metal used for coinage. Silver metal is largely used for ornamental purposes including household silverware and ornaments of personal wearing. As the bromide compound, silver finds vast applications in photography. The nitrate of silver has numerous commercial uses, including the silvering of mirrors and for medical purposes. Silver-plating from a silver cyanide bath is also commercial proposition. Silver salts are consumed in a fair quantity by the electroplating industry.

In recent years, with the rising demand of silver for industrial purposes, its importance as a precious metal has gradually faded out. Silver is no more a metal used for coinage purposes. Most of it is now utilized for industrial purposes.

India's reserves of silver cannot be considered as large, while the silver holdings of the people in India are substantial. For its industrial requirements India can safely depend on the existing stocks of silver in the country. There is, however, a considerable scope for starting the manufacture of various silver compounds needed in the photographic and electroplating industries.

SLATE

Slates, as hard clayey rocks, are often dark in colour due to the presence of carbonaceous matter. Slates are graded according to their colour, hardness, density, porosity, absorption

strength, electrical resistance and properties to resist corrosion from acid and alkaline solutions.

In India the slate stone is produced in Kangra Valley in the Punjab and in certain places in Bihar. Slate stone, associated with hard rocks, occurs in almost all parts of the country. Millions of tons of slate stone are quarried every year in all parts of the world.

The cost of slate production primarily depends on the size and design of the finished articles produced. The cost of quarrying slate is very low, whereas the price of the finished article is highly disproportionate to the original cost. Fine slate powder also fetches high price depending on the degree of fineness.

Slate is used as a roofing material and for the purpose of flooring and for making table tops, school slates and slate pencils. Articles of garden furniture are also sometimes made out of slate. Finely powdered slate is used as an abrasive and as a cheap soap additive. It is also used as a filler in paint, rubber and linoleum industries.

India's slate deposits are sufficient to meet her industrial requirements, but for building industry the same cannot be considered adequate. In fact the demand for building purposes is restricted on account of other substitutes of slate which are readily available in the country.

SODIUM COMPOUNDS

Common salt, chemically known as sodium chloride, is an indispensable item of human consumption. Other natural salts of sodium are the sulphate and carbonate of soda.

In India the common salt is mainly produced from sea. A small production of salt also comes from the Mandi rock salt mines of Himachal Pradesh. Salt production is generally confined to the coastal regions, in the States of Bombay, Madras, Orissa, Andhra Pradesh, Kerala and West Bengal. In Rajasthan salt is produced from the Sambhar Lake. Salt production on a minor scale is also being carried out in Bihar and the Punjab. TABLE No. 74 gives the salt production in India from 1935 onwards.

TABLE No. 73

Production of Salt in India

Year	Quantity Million Tons	Value Rs. Lakhs
1935	1.57	91.77
1936	1.35	73.69
1937	1.49	81.47
1938	1.54	95.18
1939	1.50	83.60
1940	1.65	96.44
1941	1.78	106.22
1942	1.89	124.69
1943	1.93	165.91
1944	1.86	246.20
1945	1.94	314.86
1946	1.94	219.99
1947	1.54	246.90
1948	2.26	433.89
1949	1.99	413.35
1950	2.57	437.62
1951	2.64	605.89
1952	2.68	525.70
1953	3.17	583.02
1954	2.52	425.64
1955	2.89	631.36
1956	3.17	695.20
1957	3.61	743.75
1958	4.14	851.38

The salt production was steadily expanding in earlier years, but a marked development took place in its production programme during the post-independence period.

Other principal salt producing countries of the world are the U.S.A., the U.K., Germany West, France, Italy, Poland, Canada and Spain. Production on a smaller scale comes from almost all countries of the world. TABLE No. 116, in the appendix gives, the salt production from a few selected countries of the world from 1950 to 1957.

Besides its use as a food material, common salt is largely used in the manufacture of heavy chemicals, like soda ash and

caustic soda. For liquid chlorine, bleaching powder, hydrochloric acid, and other chlorides the basic material is salt. On electrolytic decomposition, the salt solution gives out gaseous chlorine and hydrogen which find several industrial applications, besides both being used as a cheap source of synthetic hydrochloric acid. Common salt is used in the manufacture of ammonium chloride and a number of other chemical compounds. Some of

TABLE NO. 75

Imports & Exports of Salt

Year	*Imports*		*Exports*	
	Tons (000)	*Rs. Lakhs*	*Tons* (000)	*Rs. Lakhs*
1935-36	389.0	56.74	..	0.02
1936-37	382.2	60.49	..	0.03
1937-38	347.3	55.77	..	0.05
1938-39	312.2	37.80	7.5	1.06
1939-40	314.2	61.99	27.5	5.17
1940-41	207.2	47.72	13.6	4.50
1941-42	262.6	98.02	13.2	3.39
1942-43	133.5	88.72	0.2	0.21
1943-44	163.6	154.13	..	0.11
1944-45	275.3	249.82	4.5	2.46
1945-46	216.7	179.60	1.9	0.63
1946-47	92.6	74.22	5.5	1.62
1947-48	378.9	287.47	0.2	0.71
1948-49	300.8	203.33	8.5	2.74
1949-50	230.4	136.30	6.3	4.56
1950-51	137.1	78.94	1.9	1.52
1951-52	2.4	2.66	62.8	16.18
1952-53	2.1	2.20	213.3	51.65
1953-54	0.4	0.59	305.3	51.69
1954-55	0.02	0.30	164.4	24.99
1955-56	0.03	0.05	205.64	29.98
1956-57	..	0.24	511.57	52.27
1957-58	..	0.57	243.26	42.82
1958.59	..	0.17	324.70	45.00

these products find wide applications in industries like textiles, rayon, cellulose, paper, soap, rubber, petroleum, etc. Salt is extensively used for salting hides and skins and also for preserv-

ing fish. On account of its high solubility in water, salt is also used for preparing freezing mixtures. In soap manufacture salt is used for the separation of spent lye from soap. Chlorides of several elements owe their formation and production to common salt.

In early years the salt output in India was inadequate to meet fully the requirements of the country. A considerable quantity of salt was being imported from abroad. In recent years, particularly during the First Plan period, the production of salt in the country had been stepped up and as a result of that a certain quantity of salt is surplus and is available for exports. TABLE No. 75 gives the past imports and exports of salt from 1935 onwards.

India is potentially rich in salt. The development of the industry in the country can be planned on a lavish scale. The question of expanding country's export markets in salt can also be considered quite seriously. On realising its importance the Government of India have drawn an elaborate programme for the expansion of the salt industry in the country.

Reh or sajji, the natural sodium carbonate is found in certain alkaline soils of Bihar, Uttar Pradesh, Mysore and Bombay. The production of natural reh or sajji is no more a commercial proposition as the manufactured product is far superior in quality. The Khari salt deposits of Bihar yield from 70 to 80 per cent of sodium sulphate and that finds use in paper and glass industries. Sodium sulphate deposits are also located near Didwana in Rajasthan and are of a considerable industrial importance. These products are generally used in industries like glass, soap, dyestuffs, paper plup, textiles and in heavy chemical manufacture.

STEATITE

Steatite (soapstone or talc or french chalk) is a variety of a soft stone, having a soapy touch. In India steatite deposits are of metamorphic rocks occurring in bands and veins of loosely flake-like coherent aggregates.

Production

Steatite deposits of finest quality are found in Rajasthan; the known deposits are located around Udaipur, Jaipur, Kotah, Bhilwara and Ajmer. Deposits of commercial importance are also found in Jabalpur (Madhya Pradesh), Anantapur and Hyderabad in Andhra Pradesh, Hazaribagh in Bihar and Mayurbhanj in Orissa. TABLE No. 76 gives the steatite output in India from 1935 onward.

TABLE No. 76

Production of Steatite in India

Year	*Quantity* (000) tons	*Value* Rs. Lakhs	*Year*	*Quantity* (000) tons	*Value* Rs. Lakhs
1935	12.60	1.92	1947	20.65	10.03
1936	9.97	1.57	1948	18.10	12.06
1937	13.04	1.55	1949	21.19	10.91
1938	18.59	1.69	1950	25.48	50.48
1939	22.26	2.04	1951	35.65	13.39
1940	29.71	2.66	1952	20.77	7.64
1941	26.15	7.49	1953	29.14	16.78
1942	44.61	9.59	1954	42.33	13.28
1943	16.44	4.26	1955	42.39	15.08
1944	21.39	4.61	1956	49.86	23.47
1945	22.51	5.62	1957	44.00	18.90
1946	23.47	5.83	1958	46.03	19.55

The steatite production showed considerable fluctuations in the past. In pre-war days the production showed rising trend but in certain war and post-war years the output was relatively low. The output was again high during the First Plan period. The pit-head value of steatite also recorded a considerable rise during recent years.

Utilization

Steatite finds numerous uses in industry. Steatite blocks are used as refractory material in the construction of alkali smelting furnace for soda recovery in a paper mill. In powdered form it is used in the textile, paper, rubber and paint industries. In

soap industry talc powder is largely used as an adulterant. It is also used as lubricant and as a soft polishing medium. In the form of slabs it finds use in the construction of chemically resistant tanks, and in making switchboards. In ceramic industry it is used for the production of heat resistant products. Fine snow-white steatite powder is used in the manufacture of face powders and other scented and medicated talcum powders. Powdered steatite is used for manufacturing solid disinfectants and insecticides. Steatite blocks can be easily cut, carved, lathed and drilled, and thereby offer a good construction material for ornamental and decorative purposes.

Apart from the domestic consumption, the steatite blocks and powder find an export market. TABLE No. 77 gives the quantity and value of steatite exported out of India since 1951-52.

TABLE No. 77

Quantity & Value of Steatite Exported from India

Year	*Quantity* (000) tons	*Value* Rs. Lakhs.
1951-52	6.24	12.49
1952-53	4.98	9.52
1953-54	6.91	12.39
1954-55	7.90	13.29
1955-56	7.07	32.62
1956-57	7.47	13.87
1957-58	7.00	13.04
1958-59	7.09	11.43

India's steatite deposits are quite adequate for her domestic requirements. Efforts can be made to expand country's export market in this commodity. The main problem is to undertake the supply of a material of standard specifications.

STRONTIUM

Strontium occurs in nature as sulphate known as "celestite" and as corbonate known as "strontianite."

In India strontium deposits are reported in certain parts of Madras distributed as veinlets in clay beds. There is, however,

no production of strontium mineral in the country. World's largest producers of strontium minerals are the U.K. and Mexico. Other producers of these minerals are Canada, Germany West, Sicily and Tunisia. Certain deposits of strontium minerals are also reported from Pakistan.

Strontium compounds find industrial applications in the sugar industry and in pyrotechny Strontium hydroxide forms insoluble saccharates with sugar which on decomposition by carbon dioxide yield pure sugar. Strontium salts, particularly the nitrates, impart red and crimson colours to the flames in fireworks and by the addition of aluminium powder, magnesium powder and certain oxidising chemicals like the chlorate of potash in varying quantity, certain combination of colours can be obtained. Strontium salts are extensively used in the production of tracer bullets, signal rockets, flares and fuses in pyrotechnical applications. Strontium minerals find use in ceramics and in medicine. In metallurgy strontium is used to desulphurize steel.

In India the demand for strontium compounds is quite limited. The present requirements of the country for these salts are, however, satisfied through imports from foreign sources like the U.K., Germany West, France, Netherlands and Belgium. In 1958 India imported 59.5 tons strontium nitrate value at Rs. 1.17 lakhs as against 89.2 tons worth Rs. 1.65 lakhs in 1957. Considering the nature and extent of strontium deposits, there is a little chance of establishing a strontium industry in the country.

SULPHUR AND SULPHIDES

In nature sulphur exists both in free and combined state. Natural deposits of brimstone containing 60 to 70 per cent of sulphur are obtained in a free state; whereas in combined state, it exists as sulphides of copper or iron known as the pyrites. In natural form, sulphates also occur as gypsum (calcium sulphate) and as Khari salt (sodium sulphate).

India has practically no deposits of free sulphur. In the absence of imported product, sulphur refining was attempted

Baluchistan as a war-time project. That project proved a ilure on grounds of economy as it was found to be an expensive oposition.

In combined form, the sulphur is found as pyrites in Kash-ir, Bihar and in sub-Himalaya regions near Simla, yielding arly 40 to 50 per cent of sulphur. The roaster gases from the pper smelters operating in Bihar can be usefully converted to sulphuric acid and ammonium sulphate. The gypsum de-sits located in Rajasthan, Kashmir, Dehra Dun and Madras e also important source of sulphur.

The pyrites deposits found in Singhbhum district of Bihar, e primarily the sulphides of copper and iron. Deposits of iron yrites are also known to occur in the Shahabad district, near e Mahadeo Nala. Iron pyrites is also found at the top of jaigarh shales. Other deposits of an average sulphur content 35 per cent found at Amjor are of great commercial portance.

There has been a small production of pyrites in India in rtain past years. The pyrites deposits have not yet been com-ercially worked yet, but plans to undertake the exploitation of e Amjor deposits are under consideration.

The chief sulphur producing countries of the world are: the .S.A., Italy and Japan. Of the total world output of sul-ur more than 90 per cent comes from the U.S.A. Other lphur producing countries are: Mexico, Argentina, Chile, livia, Peru, Turkey, China, France and Spain. TABLE No. 118, the appendix, gives the production of sulphur and pyrites m selected countries of the world in certain past years.

ilization

The importance and utility of sulphur is highly recognized the chemical industry, as it is the basic raw material needed the manufacture of sulphuric acid and other allied chemicals. gar industry consumes a large quantity of sulphur in the gle and double sulphitation processes of juice refining. Sul-ur is also used in the manufacture of explosives. Other uses sulphur are in industries like rubber, match, insecticides, ferti-ers, dyes, food products and oil and varnishes. Chemicals like

the thiosulphate, sulphite, bisulphite, metabisulphite and hydrosulphite of soda owe their production to sulphur. As sulphates of soda, ammonia, calcium, magnesium, copper and iron, sulphur has innumerable uses. Sulphur is classified as a key chemical to all industries.

Country's present requirements of sulphur are met through imports, from countries like the U.S.A., China, the U.K., Germany West and certain other countries. Sulphur is imported in several forms such as roll, rock, powder and flour. A special quality of sulphur needed by rubber makers is also imported in certain quantity. TABLE No. 77 gives the quantity and value of sulphur imported into India from 1935-36 onward.

TABLE No. 78

Quantity & Value of Sulphur Imported into India

Year	*Quantity* (000) tons	*Value* Rs. Lakhs
1935-36	26.00	20.52
1936.37	29.41	21.86
1937-38	29.41	26.12
1938-39	22.28	21.74
1939-40	38.79	45.45
1940-41	38.85	50.54
1941-42	29.46	54.01
1942-43	14.73	28.49
1943-44	22.20	30.25
1944-45	19.56	35.73
1945-46	9.97	16.88
1946-47	52.37	105.74
1947-48	29.85	44.33
1948-49	38.33	61.16
1949-50	40.96	70.46
1950-51	55.33	113.23
1951-52	37.28	116.04
1952-53	73.94	250.71
1953-54	43.91	108.61
1954-55	75.97	178.22
1955-56	84.77	221.13
1956-57	104.13	308.71
1957-58	94.37	246.63
1958-59	132.56	262.69

India is very deficit in her resources of elemental sulphur and that scarcity has to continue, so long as indigenous resources of combined sulphur are not usefully utilized. In fact India has already started using gypsum for the production of ammonium sulphate in a fertilizer factory at Sindri and that has proved a grand commercial success.

Some of the natural sulphides and sulphates are cheaply and abundantly available in the country. It is desirable that the known deposits of pyrites are exploited at an early date. At the same time, economy measures in the use of sulphur may be enforced and its consumption should be restricted in the country as far as possible.

THORIUM

Monazite, the thorium ore, generally contains about 8 to 10 per cent thoria. It is obtained as a by-product during the process of ilmenite concentration.

In India monazite is obtained from the beach of sands of Kerala. Certain black sand deposits along the Indian coast from Kalingapatnam to Kakinada are also reported to contain monazite. The monazite processing plant operated by the Indian Rare Earths Ltd. at Alwaye (Kerala) produces thorium hydroxide besides other rare earth carbonates. In 1956 the thorium-uranium refinery at Trombay, near Bombay, under the auspices of the Atomic Energy Commission, went into operation.

The world's main sources of thorium ore are India and Brazil, but, in recent years, the export of monazite from these countries has been restricted. Minor production of thorium minerals, however, comes from the U.S.A., Indonesia and Ceylon.

Thoria is a potential source of fissionable material for use in atomic energy production. Monazite acts as source of thoria, which, after extraction, is converted into thorium nitrate. Thorium nitrate along with minute quantity of cerium is largely used in the incandescent gas mantle industry. Cerium is also extracted from that ore as a by-product. Cerium finds uses in the pyrophoric alloys and also in the production of pocket

lighters. Thoria is also used as a catalyst in the manufacturing process for synthetic benzine.

Prospects of thoria and ceria extraction in India are quite bright. The finished chemicals, besides finding domestic consumption, can also be exported to foreign markets. The use of thorium for nuclear purposes is gaining an increasing importance these days. Its applications in other fields are relatively less important.

TIN

The natural ore, mainly the oxide of tin, is known as "cassiterite".

Small deposits of tin ore have been located in the Archaean Rocks of Hazaribagh district in Bihar and also in Orissa. At Simratanri, it occurs in lenticles of granite enclosed in mica schist near Pihira, in a dyke of lepodolite granite, at Chappatand in a granulite. From Nurunga, near Parasnath, a thin layer of cassiterite bearing granulite is reported. Other tin occurrences are known in the districts of Gaya, Hazaribagh, and Ranchi. The country's tin ore production in the past has been practically negligible.

The chief tin ore producing countries of the world are: Malaya, Indonesia, Bolivia, Thailand, China, Belgian Congo, Nigeria and Australia. Small production comes from Portugal, the Union of South Africa, Burma and other countries. TABLE No. 120, in the appendix, gives the world production of tin concentrates and tin metal in certain past years.

Tin is largely consumed in the manufacture of tin plates and for the purpose of tinning other metallic surfaces like that of iron, copper and brass. Tin is also used in the manufacture of alloys, such as bronze, solder, type metal and white metal. Tin also finds use in the manufacture of collapsible tubes, foils and pipes. Chemical compounds, like the oxide and chloride, of tin are the well known products of industrial importance.

The current consumption of tin in India is estimated at 4000 tons per annum, in the form of ingots, bars, slabs, foils, etc. Presently country's requirements of tin, tin alloys and chemicals

are being satisfied through imports, from sources like Malaya, Singapore, China, Indonesia, Burma and other countries. TABLE No. 79 gives the imports of tin and its alloys into India from 1935-36 onwards.

TABLE No. 79

Quantity and Value of Tin imported into India

Year	*Quantity* Tons.	*Value* Rs. Lakhs
1935-36	2939	86.29
1936-37	2378	66.58
1937-38	3225	95.49
1938-39	2895	73.6
1939-40	4270	130.03
1940-41	3498	103.54
1941-42	4265	160.95
1942-43	47	2.32
1943-44	10	0.44
1944-45	69	0.35
1945-46	141	6.03
1946-47	1097	54.99
1947-48	1037	61.20
1948-49	2028	123.95
1949-50	357	251-96
1950-51	4610	405.70
1951-52	3637	489.39
1952-53	2029	248.91
1953-54	3147	290.14
1954-55	3935	382.83
1955-56	3924	357.95
1956-57	3769	473.81
1957-58	6499	422.72
1958-59	5222	447.20

India's own resources of tin are very poor. At the same time, country's requirements of tin are fast expanding. At this stage it may, perhaps, be fair to restrict the consumption of tin in the country and efforts to find out substitutes of tin should be intensified.

TITANIUM MINERALS

Titanium is usually found associated with aluminium, iron and zinc ores. The important titanium minerals are the ilmenite ($FeTiO_3$) and rutile (TiO_2).

Production

In India large quantities of ilmenite occur in the beach sands of Kerala State. In minor quantity it is also found in Bihar. Ilmenite concentrates obtained from Kerala are usually from 60 to 70 per cent purity, the rest being rutile monazite,

TABLE No. 80

Production of Ilmenite and Rutile in India

Year	ILMENITE		RUTILE	
	Quantity Tons (000)	*Value* Rs. Lakhs	*Quantity* Tons (000)	*Value* Rs. Lakhs.
1935	127.1	7.82	—	—
1936	140.5	8.30	—	—
1937	181.0	11.26	—	—
1938	252.2	15.46	—	—
1939	237.8	14.96	0.19	2.47
1940	263.2	16.48	0.92	1.22
1941	129.0	7.21	1.86	2.15
1942	49.2	3.35	2.26	2.45
1943	37.8	2.14	2.61	3.19
1944	100.8	7.39	1.65	2.07
1945	172.1	13.34	0.62	1.04
1946	185.0	17.43	0.26	0.34
1947	260.0	31.59	0.16	0.31
1948	229.4	31.37	0.13	0.25
1949	308.2	47.95	0.04	0.07
1950	212.7	33.10	0.05	0.09
1951	224.1	40.25	0.15	0.69
1952	224.9	37.30	0.10	0.13
1953	215.3	92.05	0.10	0.52
1954	240.5	79.80	0.15	1.02
1955	250.8	131.90	0.54	4.36
1956	335.6	178.12	0.47	4.73
1957	296.0	168.12	0.47	4.73
1958	309.0	183.39	0.45	4.49

zircon and quartz. Similar sands are also known to occur in coastal ranges around Ramanathapuram, Tanjore, Vishakapatanam and Ganjam. Certain deposits of titaniferrous magnetite are also known in some parts of the country and that can yield appreciable quantities of titanium as a by product.

In India the ilmenite production was hardly 400 tons in 1912, while in 1938 it was as high as 2,50,000 tons. Such an expansion in output was, in fact, due to the foreign demand for the product. TABLE No. 80 gives the production of ilmenite and rutile in India in certain past years.

Ilmenite production recorded a considerable rise in the past, while the rutile production during that period was irregular and unsteady. In recent years, particularly the post-independence period, the per unit value of ilmenite also registered a considerable rise.

The present world production of ilmenite is of the order of one million tons. The principal ilmenite producing countries of the world are: the U.S.A., India, Canada, Malaya and Norway. Ilmenite production also comes from Australia, Brazil, Egypt, Portugal, Spain and Senegal. On the other hand, the rutile output of the world is nearly half a million ton, of which the major proportion comes from Australia. TABLE No. 121, in the appendix, gives the output of ilmenite and rutile from selected countries of the world in certain past years.

Utilization

Titanium finds numerous uses in industry. The oxide of titanium is one of the most valuable fillers in the paint and pigment industry. Because of its high covering power, perfect whiteness and almost complete inertness towards variable atmospheric conditions, titanium has an important use as a pigment in plastics linoleum, coated textiles, rubber, wall paper and printing ink industries. In ceramics, glass and enamel industries the oxide of titanium has an important use. Titanium is also used in the production of ferro-titanium alloys, as it makes the steel shock-proof. It is also resistant to abrasion and helps in the elimination of blow holes. In nickel-chrome steel, the titanium provides buffer mole-

cules and thereby minimises the interangular corrosion. In arc lamps, titanium compounds along with other elements are used for making negative electrodes. Titanium terachloride is used for producing smoke screens. The sulphate and bichloride of titanium are used as intermediaries in textile industries.

Large quantities of ilmenite are exported annually out of India to countries like the U.S.A., Sweden, Germany West and Netherlands. TABLE No. 81 gives the quantity and value of ilmenite exported from India since 1953-54. Separate data for earlier years are not available.

TABLE No. 81

Quantity and Value of Ilmenite Exported from India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1953-54	200.4	114.30
1954-55	185.2	108.74
1955-56	246.2	150.50
1956-57	325.9	224.30
1957-58	330.4	242.00
1958-59	226.3	198.96

Though the oxide of titanium is being produced in India, no serious attempt has so far been made to extract the titanium metal from the ore. Prospects for the extraction of titanium in India appear to be bright. As country's resources of ilmenite are sufficiently large, efforts should be made to evolve a technique for titanium metallurgy. To achieve that a considerable developmental work is necessary. Even if the technical "know how" of the process has to be borrowed, it may be done as early as possible. The economics of the process also needs to be carefully studied.

TUNGSTEN

Tungsten ores are usually found associated with tin ores. The main ores of tungsten are iron manganese tungstate and calcium tungstate, known as "Wolfram" and "Scheelite", res-

pectively. Usually, the tungsten concentrate yields from 60 to 70 per cent of tungstic oxide.

Production

In Rajasthan workable deposits of tungsten ore are known in Rawat hills near Degana in Jodhpur Division. Small deposits of tungsten ore have also been located near Tatanagar in Singhbhum district of Bihar. Scattered deposits of the ore are also known in Madhya Pradesh. Deposits of tungsten ore at Chandapathar in the Bankura district of West Bengal are of considerable interest. In India the production of wolfram (tungsten ore) had been irregular in the past as is evident from the TABLE 82:

TABLE No. 82

Production of Wolfram in India

Year	*Quantity* (Tons)	*Value* Rs. (000)
1940	40.0	30
1941	70.0	50
1942	79.0	178
1943	77.5	361
1944	30.0	90
1945	20.0	41
1946	3.0	10
1947	—	—
1948	—	—
1949	—	—
1950	3.0	7
1951	14.0	149
1952	10.0	150
1953	17.0	180
1954	1.0	12
1955	0.6	6
1956	1.5	9
1957	1.4	8

The present annual world production of tungsten concentrates is of the order of 30 thousand tons; the main production coming from China, the U.S.A., Bolivia, Korea, Portugal, Aus-

tralia, Belgian Congo and Canada. Smaller production of tungsten ore also comes from Spain, Argentina, France, Thailand, Mexico, Brazil, Burma, Peru, Japan, South Rhodesia, South West Africa and certain other countries. TABLE No. 124 in the appendix gives the world production of the tungsten ore concentrates from some of the principal producing countries in certain past years.

Utilization

Tungsten and its alloys find extensive use in steel industry. Tungsten imparts additional hardness to steel. Also with it there is an increase in the tensile strength of steel with a limited rise in elasticity. Ferrotungstic steel alloys are largely used in the production of high-speed cutting tools. Tungsten carbide is also very hard and is used in the cutting tool industry. Tungsten filament has revolutionised the electrical industry and is widely used in the electric lamps and radio tubes. Chemical compounds of tungsten are used in pigment industry. Sodium paratungstate is found useful in fire-proofing of cloth and other fabrics. Tungsten compounds are also used as mordant in calico printing and as weighting agents. Oxide of tungsten is used in the ceramic industry for producing yellow tint in glass and porcelain. Sodium tungsten is used for decolourizing acetic acid.

It is desirable to assess the country's resources of tungsten and determine the possibilities of producing metal tungsten and its alloys in the country. Tungsten being an element of strategic importance, the scope of setting up a tungsten industry may be considered by the Government.

URANIUM

Natural minerals of uranium are the pitchblende or "Uraninite" – the oxide of uranium; "carnotite", the vanadate of uranium and potassium and "autunite", the anhydrous phosphate of calcium and uranium.

The uranium deposits are found in Canada, Czechoslovakia, Portugal, Belgian Congo, the U.S.A. and the U.S.S.R. In India the deposits of radio-active minerals are found in the Singar

mica mine in the Gaya district in Bihar and around Ajmer-Merwara in Rajasthan and in the Kerala State.

Uranium, the radio-active element, is one of the most important product of international interest. Recent developments in atomic energy research and the successful production of nuclear weapons from uranium have vitally changed the outlook of the scientists, and has opened avenues for pursuing further research on that subject. Uranium compounds find numerous uses. As carbide, uranium is employed as a sparking medium in automatic cigar lighter. Enclosed in quartz globe and surrounded by an inert atmosphere, uranium electrodes emit rays rich in ultra-violet band. Uranium salts are used as colouring agents in the manufacture of glass, yielding opalescent yellow colour. Uranium oxide imparts golden glaze to pottery and yellow and organge colours to glass. Uranium salts are used as mordants in silk and wool industry. In the synthetic ammonia production, uranium salts are used as catalyst. In photography, uranium nitrate is used as a sensitizing agent. There are several other minor uses of uranium and its chemical compounds.

The task of prospecting radio-active minerals has been taken up under the auspices of the Atomic Energy Commission. The Commission has drawn an elaborate programme to survey for the radio-active mineral deposits. A plant for the recovery of uranium has been set up. Nuclear reactors are also under construction as one of the steps towards making a peaceful use of atomic energy. With the available financial and technical facilities it may be possible to strengthen country's defence resources and also make use of atomic energy for peaceful purposes.

VANADIUM

Vanadium occurs in natural form as "carnotite" (uranyl potassium acetate), "patronite" (greenish coloured sulphide of vanadium) "roscoelite" (vanadated muscovite mica) and as "vanadinite" (chloro-vanadate of lead).

In India iron ore deposits in the Mayurbhanj area in Orissa and Singhbhum district in Bihar are known to bear a small proportion of vanadium and titanium. Minor occurrences of vana-

dium oxides are also detected in the Warkalli lignite beds in Kerala and in the green mica deposits in Bhandara district. The vanadium contents of the ore are from 0.5 to 0.8 per cent. The recovery of vanadium is somewhat difficult, but after the titanium extraction is completed, certain quantity of vanadium can be obtained on further processing.

The world production of vanadium was estimated at 7 thousand tons in 1957, of which 94 per cent came from the U.S.A. Vanadium ores also occur in South-West Africa, Peru and North Rhodesia. Small deposits are also located in Australia, the U.K., New Zealand, Argentina, Spain, Germany and the U.S.S.R. TABLE No. 122, in the appendix, gives the vanadium ore output from selected countries of the world from 1947 to 1957.

Vanadium increases the elasticity and tensile strength of steel, without affecting the ductility. Vanadium is chiefly used for the production of ferro-alloys in steel industry Copper-vanadium alloys are much used in the production of solid copper-castings and bronzes, as well as in the manufacture of certain aluminium alloys. The chloride of vanadium finds use in photography. Pentoxide of vanadium is used as a colouring material in pottery and glass industries. Vanadium pentoxide is successfully used as a catalyst in the "Contact Process" in the sulphuric acid manufacture with the result that cost of acid production has come down considerably. Minor uses of vanadium salts are in the medical field, and in other industries like paint driers, insecticides, fungicides and fertilizers.

It is difficult to estimate India's reserves of vanadium as assessment of the country's resources is not yet complete. The processes of vanadium extraction, refining and utilization are not yet commercialized in India. A considerable research work is necessary before it is possible to establish a regular vanadium industry in the country.

VERMICULITE

Vermiculite, the micaceous mineral, is a complex hydrated aluminium magnesium silicate, which on dehydration exfoliates into lenticular and irregular shaped mass.

Vermiculite deposits are found in Ranchi district in Bihar, Ajmer-Merwara in Rajasthan, Hassan, Kolar and Tumkur districts in Mysore and Bankura district in West Bengal. Production of vermiculite on a minor scale has been reported from the Mysore State.

World's chief producers of vermiculite are the U.S.A., the Union of South Africa, Southern Rhodesia, Australia, East Africa and certain other countries. TABLE No. 123 in the appendix gives the output of vermiculite from certain selected countries of the world in certain past years.

As on heating vermiculite expands 10 to 15 times its original volume, it finds use as an insulation material for thermal and accoustic purposes. Vermiculite bricks are extensively used for the construction of furnace tops. Other constructional materials, such as the precast light-weight slabs, roofing tiles and fire proofing compositions for walls are made out of vermiculite.

Country's requirements of vermiculite are at present being met by imports from the U.S.A. and the Union of South Africa. In 1957, 7.4 lakh insulating bricks worth Rs. 16.63 lakhs were imported into India from the U.K., the U.S.A., Germany West, Japan and Denmark. However the number of bricks imported in 1958 was only 3.4 lakhs valued at Rs. 3.13 lakhs.

Experimental work to assess the quality of Indian vermiculite is in progress at different places in the country. As a result of research work done in one of the National Laboratories in India, bricks made from waste mica are found as good as vermiculite bricks. It may also be possible to initiate further work on the production of synthetic substitutes of vermiculite and other similar products in the country. The existing reserves of vermiculite can be effectively utilized, if the experimental work already in progress results in a commercial success. Vermiculite production can be encouraged in India, provided the quality of the product is approved by the consumers.

ZINC

In nature, zinc occurs together with lead as sulphide. It is commonly known as lead-zinc ore and also contains other metals like copper, silver, gold, bismuth, tin, etc.

Production

The lead-zinc deposits are found in the Zawar mines in Merwara in Rajasthan. Zinc sulphide ore is also known to occur near Darabi in Kashmir State. The Bawdwin lead-zinc mines of Burma, have all along been acting as a source of raw material for zinc smelting in India. In India, the zinc (concentrate) production was started only a few years back. A considerable expansion in the output of zinc concentrate took place in a short period. TABLE No. 83 gives the production of zinc concentrates during the last nine years.

TABLE No. 83

Production of Zinc (Concentrates) in India

Year	*Quantity* Tons (000)	*Value* Rs. Lakhs
1950	0.66	1.80
1951	2.11	6.50
1952	3.87	10.52
1953	4.30	11.70
1954	3.97	10.81
1955	4.87	16.50
1956	6.88	23.16
1957	7.47	25.32
1958	7.25	20.41

The present world output of zinc ore is of the order of 3 million tons; the principal sources of production being the U.S.A., Canada, Mexico, the U.S.S.R., Australia, Peru, Italy Belgian Congo, Japan, Germany West, Spain and Poland. Other zinc ore producing countries are: Sweden, Yugoslavia, Bolivia Argentina, French Morocco, Northern Rhodesia, South West Africa and certain other countries. TABLE No. 125, in the appendix, gives the output of zinc concentrate and zinc metal from selected countries of the world in certain past years.

Utilization

Zinc is largely used in the galvanising industry. In the mechanical process of galvanizing, articles are dipped in a molten zinc bath and in the electrolytic process, the desposition of zinc metal from zinc salt baths is carried out electrolytically. Zinc is an important ingredient of brass, a copper-zinc alloy. Zinc is also used in the manufacture of batteries and for die castings. The oxide of zinc, an important compound, is used in the paint, rubber and latex products industries. Lithopone, a product of interest to the paints and rubber industries, contains about 28 to 30 per cent zinc sulphide.

TABLE No. 84

Quantity and Value of Zinc or Spelter imported into India

Year	Quantity Tons (000)	Value Rs. Lakhs
1935-36	24.35	51.95
1936-37	23.82	53.59
1937-38	22.36	76.86
1938-39	26.14	54.60
1939-40	23.25	59.82
1940-41	22.66	95.79
1941-42	15.53	100.72
1942-43	12.00	74.00
1943-44	1.68	8.84
1944-45	2.98	20.14
1945-46	12.83	73.80
1946-47	53.76	358.36
1947-48	27.93	238.38
1948-49	37.59	407.79
1949-50	30.49	365.09
1950-51	37.72	655.80
1951-52	21.09	735.39
1952-53	23.06	454.19
1953-54	29.78	359.75
1954-55	44.49	529.10
1955-56	29.07	415.43
1956-57	36.31	571.63
1957-58	65.80	793.34
1958-59	54.56	547.99

In prewar years the country's annual consumption of zinc metal, alloys and its chemical compounds, was more than 25,000 tons. The current requirements of the same have been estimated at 8,000 tons for alloy making and 18,000 tons for galvanizing, 4,000 tons as zinc oxide, and 3,000 tons as of zinc chloride. The oxide of zinc and certain other compounds are now being manufactured in India. A major part of the present requirement of the metal, alloys and its chemicals is being satisfied through imports from Australia, Canada, Belgian Congo, Rhodesia North & South, Mozambique, Japan, Czechoslovakia, Yugoslavia, the U.S.S.R., the U.K. and other countries. TABLE No. 84 gives the quantity and value of zinc spelter imported from 1935-36 onward.

Compared to the prewar and war years the current requirements of the country in zinc metal have considerably gone up. To a certain extent the indigenous production of zinc concentrates has also improved, but, the gap between the demand and supply still remains very wide. The consumption of zinc and its compounds in the country should be restricted as far as possible.

ZIRCON

Zircon, the silicate of zirconium, is obtained in India from the ilmenite sands of Kerala. The ore yield from the sand is about 5 to 6 per cent, the ZrO_2 contents of which are nearly one-third.

In India, the zirconium ore is obtained as a by-product in the ilmenite concentration process. Separate statistics of production are not available. India is one of the large producers of zircon in the world. Other zircon producing countries of world are: Australia and the U.S.A. Deposits of zirconium oxide are also known in Brazil, Egypt and French West Africa. TABLE No. 126, in the appendix, gives the production of zirconium concentrates from selected countries of the world from 1947 to 1957.

Zirconium and its salts find numerous industrial uses. Pure fused zirconia because of its low-co-efficient of expansion, is used as a refractory material, especially in crucibles and certain high temperature furnaces. It is also used in the ceramic in-

dustry for the production of special type of procelain and glass-ware, and as an opacifier in certain enamel compositions. Zircon is also used in the production of radio tubes, ammunition primers and in electric welding. Zirconium in elemental form has a little use, although it has been tried as a filament in incandescent electric lamps. As ferrozirconium in the steel alloy production it is consumed in minor quantity. A small quantity of zirconia in quartzware increases its tensile strength and its resistance to chemical action. Zirconia carbide is a good abrasive and can be used for cutting glass. Zirconium compounds like the oxide, the silicate, the basic carbonate, the phosphate and the sulphide are used as non-poisonous pigments which possess high covering power. Zirconium compounds find use in incadescent glow lamps. Zirconium acetate also finds use for weighting silk.

In India research facilities are needed to develop the technique for the extraction of zirconium from the ores. Since applications of various products obtained from zirconium are not fully known in India, a considerable work in the applied field is necessary to demonstrate its utility in industry.

CHAPTER IV

PROBLEMS OF THE MINING INDUSTRY

India's mineral resources though limited, are by no means considered inadequate, as a sufficient range of useful products, required for country's self sufficiency, are available in the country. The available resources of certain minerals are ample and are sufficient to prepetuate economic activity both in the industrial and commercial sphere. In certain minerals of strategic importance, the country is, however, deficient.

While the programme of mineral development, formulated under the Five-Year Plans, is in the process of implementation, the actual progress made in production planning is a concern not only of the planners alone but of those actually engaged in the industry. The day-to-day reforms brought about in the mining legislation and the mineral policy adopted by the Government are greatly instrumental in moulding the ultimate shape of the industry.

Apart from whatever steps are taken by the Government to promote the growth of the industry, its development has to be viewed in the light of the various problems faced by the industry. Vital issues like the mineral policy and investment trends, the problems of transport, the supply of labour, the conservation of minerals, the mining legislation and controls, the fabrication of mining machinery, the mineral taxaxtion, the marketing and utilization of minerals, the foreign markets and international competition, the export policy and the state trading in minerals, the technology and research in mining, on which rests the future development of the mining industry, are discussed in the following pages. Prospects of future development are also indicated in the end.

Plan Targets

In developing country's mineral resources, the Government have shown keen interest in the post-independence period, espe-

cially with the commencement of the First Plan. Production targets for a number of industries have been fixed by the Planning Commission. For some of the industrial projects, estimates of production and consumption of minerals and metals have been specified. TABLE No. 85 gives an indication of the likely expansion in some of the minerals and mineral based industries by 1960-61.

TABLE No. 85

Expansion programme in minerals and mineral based industries

Actual Production (1956-58) *and targets*

Product/Project	Unit	Targets for 1960-61	*Actual Production*		
			1956	1957	1958
Coal	000 Tons	60000	39430	43500	45340
Iron Ore	„	12500	4860	5074	5944
Manganese Ore	„	2000	1687	1654	1230
Gypsum	„	1970	850	922	790
Limestone	„	23300	8194	9420	10094
Bauxite	„	175	91	97	115
Steel finished	„	4300	1338	1347	1299
Pig iron (Foundry)	„	750	440	295	432
Aluminium	„	25	6.5	7.8	8.2
Ferromanganese	„	160	24.0	4.6	44.3
Cement	„	13000	4928	5602	6068
Refractories	„	800	318	367	414
Fertilizers					
a. Nitrogenous*	„	290	78	76	77
b. Phosphatic†	„	135	81	142	167
Soda Ash	„	230	84	92	89
Caustic Soda	„	135	39	43	56
Sulphuric Acid	„	470	165	196	227
Paints & Varnishes	„	60.0	41.6	42.3	47.8

* Fixed nitrogen.

† Super Phosphate

Based on the production targets of some of the industries listed above the requirements of raw materials by 1960-61 have also been estimated as under (TABLE No. 86).

TABLE NO. 86

Estimated Requirements of Minerals by 1960-61

Project	*Raw Materials*	*Estimated Requirements by* 1960-61
Iron & Steel	Coal	11.30 Million Tons
	Iron Ore	11.16 " "
	Manganese Ore	0.31 " "
	Limestone	3.24 " "
	Dolomite	0.59 " "
Ferro-manganese	Manganese Ore	0.32 " "
	Coke	0.09 " "
	Limestone	0.08 " "
Aluminium	Bauxite	0.113 " "
Cement	Coal	5.85 " "
	Limestone	18.75 " "
	Gypsum	0.62 " "
Fertilizers		
a. Nitrogenous	Gypsum	1.30 " "
b. Phosphatic	Rock Phosphates	.0.42 " "
Sulphuric Acid	Sulphur	160.0 Thousand Tons
	Pyrites	7.0 " "
	Gypsum	20.0 " "
Soda Ash	Salt	460.0 " "
	Limestone	400.0 " "
Caustic Soda	Salt	270.0 " "
	Mercury	0.5 " "
Calcium Carbide	Limestone	48.0 " "
	Charcoal Coke	24.0 " "
	Electrode Material	8.0 " "
Refractories	Coal	250.0 " "
	Fire Clay	520.0 " "
	Bauxite & Kyanite	40.0 " "
	Silica Stone	40.0 " "
	China Clay	2.5 " "
	Magnesite	16.0 " "
	Chromite	5.7 " "
	Feldspar	0.5 " "

Project	*Raw materials*	*Estimated Requirements by 1960-61*	
Glass	Glass Sand	200.0	Thousand Tons
	Soda Ash	70.0	" "
	Lime	32.0	" "
	Borax	4.0	" "
	Saltpetre	0.8	" "
Sugar	Limestone	235.0	" "
	Coal	220.0	" "
	Sulphur	14.0	" "

Compared to the production targets of most of the minerals and mineral based industries fixed for 1960-61, the actual output attained by 1958 appears to be fairly low. From the past annual rate of expansion in some of the important industries there is an ample justification to believe that it may be difficult to achieve the targets in the specified time.

The development in the field of mining is, in fact, dependent on the progress made by the mineral based industries. At the same time, the development of some of the mining industries like that of mica, manganese ore, kyanite etc., depends on the foreign demand. Even though, there may be a persistent demand for some of these minerals, the actual output and the production operations are affected by a number of factors, some of which are given below.

Mineral Policy & Investment Trends

In pursuance of the Industrial Policy Resolution of 30th April, 1956, some of the mining and mineral industries, along with others, are grouped under three broad categories.

Industries belonging to the first category are those, the future development of which is the exclusive responsibility of the State. All new units in that category, save when their establishment in the private sector has already been approved, have to be set up only by the State. That does not preclude the expansion of the existing privately owned units and the possibility of the State securing the co-operation of private enterprise

in the establishment of new units when the national interests so require. Industries in that category are: coal and lignite, mineral oils, mining of iron ore, manganese ore, chrome ore, gypsum, sulphur, gold and diamond, the mining and processing of copper, lead, zinc, tin, molybdenum and wolfram and minerals specified in the Schedule to the Atomic Energy (Control of Production and Use) Order, 1953, i.e. pitchblende, columbite, samarskite, uraniferous, allanite, monazite, uranium bearing tailings left over from ores after extraction of copper or gold, ilmenite, zircon, rutile and beryl.

The second category of industries is to be progressively State-owned and in which the State has taken initiative in establishing new undertakings, but in which the private enterprise is also expected to supplement the efforts of the State. Industries in the second category embrace all minerals except "Minor minerals" as defined in Section 3 of the Mineral Concession Rules 1949. All other minerals include: bauxite, limestone, steatite, marble, barytes, feldspar, quartz, magnesite, dolomite, industrial clays, glass sand, refractory minerals, pigment minerals, asbestos, abrasives, sillimanite, etc. etc.

The remaining industries which include "Minor minerals"* fall under the third category and their development has to take place ordinarily through the initiative and enterprise of the private sector.

In pursuance of the revised Industrial policy the expansion of mining industries has to take place only in the public sector, and further expansion in the private sector is to be discouraged. Though the private sector is fully assured of its existance in the future yet there is a doubt about its future status. With the threat of nationalization on hand, the private sector is left with no incentive to continue developing the mining industry. With

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* Minor minerals means building stone, builder, shingle, gravel, kankar and limestone used for lime burning, murrum, brick-earth, fuller's earth, bentonite, ordinary clay, ordinary sand, road metal, reh-matti, slate and shale when used for building material.

certain temporary benefits in view, the private enterprise cannot contribute much in the development programme.

In recent years, the National Coal Development Corporation and the National Mineral Development Corporation have been brought into existence in the public sector. With limited resources and with little experience at their back these Corporations are likely to take a considerable time in organizing a country-wide production of minerals. At this juncture, when demand for minerals is expanding rapidly the private sector should be given a proper encouragement, especially when the resources of the public sector are limited. To continue investing in the industry without any reservation and to maintain the rising tempo in production the private sector needs proper incentives. Both the private and the public sectors should work in harmony so as to seek each others cooperation in the expansion programme of the mineral industry and in raising its productivity.

The Problem of Transport

Mining areas in some of the states are in places far away from the regular orbit of communication. Certain mineral-bearing regions are in hilly tracts and are inaccessible. In certain cases, the mine owners are supposed to build their own roads up to the points where they meet the national highways. The developmental cost and the maintenance of labour, in mines located in isolated places is sometimes very high. The road transport facilities are limited on certain sections. The cost of lifting and carrying minerals from pit-heads having disadvantageous location is always high. The usual cost of transportation from the mine to the rail-head is high and that adds to the ultimate cost of the mineral.

On road, the bullock cart and truck operators sometimes demand unreasonable charges for mineral haulage, depending on the nature and volume of the traffic. In certain mining areas, the transport operators form monopoly rings with the result that the mineral trade has often to pay high transport charges. That problem can be partly solved by granting additional licences to more operators on sections where the existing number is already small. In mining areas, there is an urgent need to standardize

the freight charges on road. The condition of roads in certain mining areas is also very bad and in rainy season some of them become unmotorable. The question of affording better transport facilities and of minimizing the cost of mineral transportation on roads is intimately linked with the development programme.

The railways too have their limitations. Traffic on certain sections is quite congested. Sometimes the railways find it difficult to cope up with demand for wagons. With a limited supply of wagons, the railways have also to satisfy other indentors who requisition wagons for a number of other commodities. With rising demand for wagons, the strain on the transport system has increased indefinitely. The inland mineral traffic meant for domestic consumption handled by the railways is generally in accordance with the requisition of wagons and the available capacity. Sometimes the non-availability of wagons and certain administrative delays in the allotment procedure are reported.

The supply of minerals from the nearest point of production can be of help in minimizing long distance haulage. That arrangement can be successful only if the producer of a mineral is able to satisfy the consumer in the matter of quality, the bulk of supply and the price of the product in question. The procedure for requisition and allotment of wagons and the efficiency with which these are actually used is also a matter of a detailed enquiry. The use of empty run of wagons for the purpose of mineral traffic can also be studied with some advantage and that may be specifically useful for the mineral traffic meant for export.

In India the development of mining industry can take place more effiectively, if wagon supply for mineral traffic is made available promptly and regularly. With improved loading and unloading facilities, the idle hours of wagons can be curtailed. Based on the time and motion study, the loading and unloading time of a wagon can also be standardized.

The Size of Organization & Mining Cost

The size of a mining establishment is denoted by the amount of capital invested in that or by the physical output of the indus-

try or by the number of workers employed in that organization. With the exception of a few joint-stock companies, the mining industry in India is generally controlled and managed on a proprietory or a partnership basis. Not more than 5 per cent of the total mining units in the country could be classified as large and the rest of the establishments are either medium of small scale. The smaller units generally do not possess adequate resources to undertake the development work. A number of establishments operate uneconomically. Small scale operators suspend production as and when the margin of profit comes down. They work intermittently and do not guarantee employment to their workers. With a view to improve their working conditions the small scale units could be discouraged in the national interest. It cannot help in achieving the high standard of productivity in mining. In several ways it retards the developmental work.

Apart from the mining cost, the incidence of lifting and carrying minerals from the pit-head to points of consumption or other destinations considerably affects the ultimate cost of the product. That is sometimes very high in the case of a mine having a disadvantageous location. The nature of mineralogical deposits and the amount of overburden present also inflence the pit-head cost. As the cost goes up, the operations of such mines become uneconomic. Some of the mines can function economically only when a certain minimum price is guaranteed for the minerals produced. Such mining establishments fall under the category of marginal units. In order to utilize the country's natural resources effectively, the problem of marginal mines may have to be studied more thoroughly. Some times the mining operations of such establishments may have to be subsidized at the cost of other prosperous units. In the case of strategic minerals particularly for national defence, the State should consider to exploit such minerals.

The Supply of Labour

As mining industry is a potential source of employment, its importance is now fully recognized in the country. In India, more than half a million workers are engaged in the mining

industry. With further expansion in that field avenues for additional employment have improved a good deal. In mining areas the demand for workers both of skilled and unskilled type has increased considerably. Generally, labour is in short supply in some of the mining areas, particularly where mining operations are seasonal. Usually workers seeking employment in mines belong to the agricultural class. Very often they go back to their native places for agricultural work. Living conditions in mining areas are also not quite attractive for a worker to seek permanant attachment with the mining work. Even the semi-trained workers keep on changing their places of employment very often. There is a great shortage of skilled workers and technicians in mining areas. There are also no labour training centres. The working conditions in some of the mining regions are far from satisfactory. The unstable character of mining establishments, particularly the small ones, which work intermittently are largely responsible for the uncertain supply of labour.

The Conservation of Minerals

Perhaps the popular concept of mineral conservation is the efficient use of available resources, allowing minimum wastage in the processes of production and utilization, thus resulting in the saving of raw materials. The conservation of minerals is in fact the course adopted to eliminate wasteful methods of production and consumption. A careful and planned use of resources can help the reserves to last longer. With whatever available reserves of minerals the country has, the idea of deriving maximum benefit out of that can be effectively materialized by rationalizing the mining practice in the country.

With the motive of making quick profits, the mine operators generally resort to selective mining. In recent years, the Government of India under the Mineral Conservation and Development Rules, 1955, imposed restrictions on the wasteful methods of production of certain minerals, directing the producers to undertake mining operations systematically. The country cannot afford to lose its precious reserves of minerals allowing the mine operators to follow wasteful methods of production. The con-

servation of minerals has no doubt a direct impact on the production efforts; but in the long run the ultimate interest of the country is rightfully served by enforcing conservation measures. Its effect is felt immediately in the case of minerals in short supply while for those found in abundance the real effect may be perceptable after some time. At present, only a few important minerals are covered by the present legislation. It is time that all minerals, without exception, are brought under the purview of the Conservation Rules. The question of the conservation of all minerals is really pertinent.

Mining Legislation and Controls

With a view to regulate production and to bring about proper development in the mining industry, the Central and some of the State Governments have enforced certain legislative measures. Since 1948 the Government of India, are excercising an overall control on the mining industry, through the Mines and Minerals (Regulation & Development) Act, 1948. Under the Act, the control measures on certain specific minerals home been further extended by framing the Mineral Concession Rules and the Mineral Conservation and Development Rules. Some of the State Governments, too, have their own legislations. On the side of labour employment, the Central and State Governments have also a separate legislation prescribing the working conditions of labour, such as the working hours, the minimum wages, the employment of adolescents and children, the safety of mine workers, etc. For atomic minerals separate control orders are in force. There is also a movement control on some minerals. To place a check on import and export of certain minerals and metals, the government have formulated a separate policy. Then there is a State trading in certain minerals, canalizing the exports through the State Trading Corporation of India. The administration of several controls through different authorities has made mining a complicated affair.

In India, the mining industry is in an underdeveloped state and the various legislative measures enforced considerably retard its growth. The mining legislation if simplified, the controls being left to in the hands of a fewer authorities, would help

in bringing about a much healthier growth of the industry. With a minimum of overlapping in the work, a perfect liaison is necessary between the Central and State Government Departments dealing with mining industry. That is likely to facilitate the promotion of the mining industry and may accelerate its growth.

Fabrication of Mining Machinery

As compared to other industrially advanced countries of the world, the mining industry in India is not quite modernized. Mining operations are usually carried out by the manual labour. With recent developments in the field of mining, the industry's requirement in machinery and mechanical appliances has gone up considerably. The machinery required by the mining industry generally consists of: the drilling and blasting equipment, earth removing equipment, power generating sets, water pumping units, rails, tubs and trolleys, etc.

There is no organized production of mining machinery being carried out in India. Equipment is generally imported and sometimes fabricated against orders. The needs of the mining industry are not specifically looked after by any particular section of the trade, except that certain intermediaries attend to the business of spare parts. For service and in the case of a breakdown of machinery the industry has to contact its supplies in port towns, like Calcutta and Bombay. There is an urgent need to organize the production of mining machinery in India.

Mineral Taxation

The mining industry and mineral trade in India bear several types of taxes. Besides the normal business tax on income, the mine operator has to pay mine acquisition fee in the form of royalty payable periodically, the dead rent and the surface rent payable annually. On some minerals there is a cess levied on production. Then there is an export duty on a mineral like manganese ore. The schedule of dead rent and surface rent and the royalties are fixed from mineral to mineral. Accordingly to the Indian industry the taxation on minerals is high and that does not leave enough incentive for further development of the industry.

For exploitation and development of the mineral reserves, the mining industry has generally to incur heavy expenditure on operations which are hazardous and uncertain in nature. Mining is usually considered as a risky business. Mining operations involve a high expenditure on the acquisition of mineral property or the right to work the mines. The priliminary expenses are on mineral exploration and ascertaining their existence and location and to determine the extent of deposits. That is followed by the developmental expenditure required to set the unit ready for mining operations. Further capital has to be blocked in buildings, machinery or plant. As it is the mining industry in India is undeveloped and in the initial stages requires encouragement to promote its growth. With a view to develop the industry, the Government may well consider to allocate larger sums of money from out of the revenue collected from minerals and to spend on road building and in affording better facilities to the industry and trade.

Marketing and Utilization of Minerals

While the Government are doing a good deal to develop the mining industry in the country, some of the basic problems faced by the trade remain unsolved. The problem of marketing and utilization of minerals is perhaps the most vital one, on which depends the production programme. Not much information is available to the industry on the marketing aspect of minerals. When once the conventional line of trade is dislocated, on account of one reason or the other, the only course left to the mine operators is to suspend production. As a result of irregular demand, the mine output starts fluctuating. Prospects of stepping up mineral production can be improved, if the industry is given assistance by the Government through the dissemination of information on the marketing and utilization aspect of minerals. The government, instead of undertaking production of minerals themselves, would do more service to the industry by sponsoring market surveys of minerals both in the domestic and foreign markets. The market surveys of minerals could be undertaken with the help and co-operation of the industry.

Sometimes the mine owners who sell their product to the

middleman never know as to how and where the product is finally disposed off. The actual point of consumption remains unknown to them. At the same time the consumer industries do not get in touch with the mineral producers. The Government could do a lot in bringing together the producers and consumers and acquaint the producers with the utilization aspect of minerals. That would enable the mine owners to produce minerals of requisite standards needed by the consumers.

Foreign Markets & International Competition

Quite a number of minerals find their market abroad. With rapid industrial expansion in some of the foreign countries, the demand for the Indian minerals has increased considerably. Of the various minerals exported out of India, the important ones are: manganese ore, mica, iron ore, ilmenite, kyanite, magnesite, coal and chromite. Minerals like bauxite, asbestos, barytes, chalk and lime, sillimanite, salt, saltpetre, steatite, etc., are also exported from India. Of the various western markets, the U.S.A. is the principal importer of manganese ore, mica, ilmenite, kyanite, magnesite, chromite and sillimanite. Germany, the U.K. France and Italy are also important markets for some of these minerals.

Iron ore is exported to Japan, Czechoslovakia, Belgium, Germany West, Poland, and to some of the East European countries. Coal is exported to the neighbouring countries including Pakistan, Ceylon, Burma, Hongkong, Japan and Korea. Ilmenite is mainly exported to the U.S.A., the U.K., and other countries and kyanite to the U.K., Belgium and others. Maganese ore is exported to the U.S.A., the U.K., Japan, Germany West, France, Italy, Sweden Norway and other countries. Mica is mainly exported to the U.S.A., the U.K., Germany, Netherlands, France, Japan, Australia and other countries.

From the figures of past export of minerals, given in the earlier chapter, it is evident that the foreign demand for some of the minerals had been fluctuating widely. That is why it was never possible for some of the mining industries in India to stabilize their production.

The export trade is very much affected by the competition which some of the Indian minerals face in the international

market. In certain minerals there has been a keen competition from other countries of the world. For instance, Brazil, the U.S.S.R., the Union of South Africa and Ghana are India's main competitors in the manganese ore markets. Similarly, there is a competition in the iron ore trade from suppliers like Sweden, France, Canada and countries from South America and the African continent. In the case of mica, a threat from the use of substitutes is gaining ground every day. For other minerals also the demand from foreign markets is not quite steady.

At no stage efforts have been made to assess the foreign demand for minerals and the future potentialties of the foreign markets. With a view to organize indigenous production of minerals on a sound footing, the question of stabilizing foreign markets has to be considered very seriously. Periodical surveys of foreign mineral markets, reviewing particularly the price structure, the consumption pattern and the demand forecast for minerals may be considered very essential before the development of industry is planned.

Export Policy and State Trading in Minerals

The country has become export conscious in recent years. In the export of minerals, the Government have adopted a liberal policy. With the exception of a few, the export of all minerals is allowed. The policy in regard to mineral exports is announced periodically. To supplement the activities of the private sector, the state trading in metalliferous ores was introduced from 1956. In the same year, the Export Promotion Council for Mica was also brought into existence.

In building the country's export trade in minerals the Government seem to be pretty serious. The various steps taken by the Government to implement its policy of promoting exports in minerals are fully appreciated. The State trading in iron ore, manganese ore and chromite has brought about a major change in the conventional channels of distribution. The participation of the State Trading Corporation in the mineral export trade and from the experience it has been able to gain in the course of three years, there is strong case to justify its existence. At the same time the failure on the part of the Corporation to stabilize

the country's export trade in manganese ore is enough to disqualify the State from trading in ores. With little experience at its back and with large overhead and high administrative expenses, the State Trading Corporation cannot handle the ore trade as economically as is done by the private sector. The Government could well consider the possibility of setting up an export promotion council for minerals. By taking the private sector into confidence, the problem of mineral exports could be handled with a great advantage.

Technology and Research in Mining

The mining practice and the process of mineral extraction are the technical jobs requiring the services of duly qualified geologists, minerologists, mining engineers and technicians including skilled workers. In most of the mining industries in India, the extraction of minerals and ores is carried out through surface mining which involves the working on an open-cast method and operating on a bench system. With the exception of coal and gold, underground mining is not much known in India.

In accordance with the provisions of the Mines and Minerals (Regulation and Development) Act, the mining operations are to be conducted under the direct supervision of the qualified geologists or mining engineers. With expanding needs of the industry both in the private and public sector there is general dearth of qualified technical people in the mining field.

Some of the Universities in India have regular courses in geology and mining but there are no regular centres where practical training is imparted to the workers. For undertaking geological and geophysical surveys, prospecting and mining work the industry's man-power requirements are fast expanding. For learning deep and underground mining no facilities exist in the country. Ordinarily each and every mining establishment should have a separate technical staff for undertaking the developmental work.

Research in mining is also an essential item of the programme connected with the development of mining industry. The Government have certainly taken a right step in establish-

ing a Mining Research Station at Dhanbad, but the problems of the entire industry cannot be solved by that station alone. On zonal basis that station should be able to tackle the problems of the industries located in Bihar, Orissa and West Bengal. There is a need for more research institutes to attend to the needs of the mining industries located in southern, western and central parts of the country.

Development Prospects

With a programme of rapid industrialization in recent years, the development prospects of mining and mineral industries in India have improved considerably. The present level of development in the field of mining in the country is attributed to the rising domestic consumption of minerals, as priority is being given to the establishment of basic industries in the country. Apart from that, the expansion of the indigenous mining industry has taken place on account of the larger foreign demand for some of the Indian minerals. With further rise in foreign demand, a still larger expansion of certain mineral industries can be planned. The growth of the mining industry can be readily accelerated if facilities for transport and shipping of minerals are improved.

With the establishment of basic industries like the steel, aluminium and fertilizers in the country, the domestic consumption of some of the minerals has gone up, and as a results of that the development in some of the mining industries producing iron ore, coal, manganese ore, chromite, bauxite, gypsum, refractories has been quite marked. With the expansion of cement, ceramics and glass industries, the demand for limestone, clay, silica sand and certain other minerals has increased. It is quite certain that with an all-round industrial expansion in the country, the growth of the above-mentioned mineral industries is more or less assured but the rising trends in output alone do not guarantee the ultimate development of the industries. In certain minerals a shift in demand from domestic to foreign and large fluctuation in the price level or *vice-versa* can disturb the equilibrium of the industry concerned. Even with minor change in the normal channels of distribution or with the failure of the

supply line, the industry is likely to receive a setback. The prospects of development in some of the mining industries can be brightened up by drawing a long-range production and consumption schedule. A closer liaison between the mine operators and the consumers can be of great help in organizing production of minerals on a sound footing.

As the development of certain mineral industries like mica, manganese ore, ilmenite, kyanite, magnesite, sillimanite, etc., is dependent on foreign demand, their production planning cannot be quite sound unless the mine owners are fully assured of their export markets. It may be possible to foresee the potentialities of the export markets by conducting a mineral-wise survey of market demand and by examining the pattern of consumption of each individual mineral. With a complete knowledge of the domestic and foreign markets and a sound assessment of the total demand of minerals, it may be possible to plan production on sound lines. The Government could assist the industry by undertaking periodical surveys of markets and bringing the results of such studies to the knowledge of the industry.

As certain minerals are a valuable source of earning foreign exchange it may be essential to build India's export trade in minerals as far as possible to the optimum level, keeping a due margin for the domestic requirements. The various measures necessary to promote exports of minerals should be adopted wherever possible. On the basis of assured foreign markets it may be possible to stabilize the production trends. A continuous watch on the price line and its movement, the pattern of supply and consumption of minerals in foreign countries and a comparative study of different sources of supply in the international market could be of great value to the Indian mineral trade. At the same time, the shippers from India could compete well with the world's other sources of supply by keeping the level of prices to the lowest possible extent. In order to improve the competitive strength of the Indian products in the world market, the cost of production and transportation of minerals should be brought down as far as possible. By adopting an improved technique of production the ultimate cost could be lowered down. By keeping a check on the road transportation cost and

offering better transport facilities, the industry can be established on a firm footing. The rail transport capacity being limited, the mineral industry needs an extra care for being offered prompt despatch facilities. The railway freight charges for the mineral traffic are high and the same should be revised downwards. Mineral traffic for export purposes should be subsidized in its transport cost to enable that to stand the foreign competition. Foreign shipping companies sometimes charge preferential cargo freight, and thus make the haulage of Indian minerals more expensive. That hurdle could be crossed by expanding India's own shipping industry. In the national interest the shipping freight could be made elastic so as to suit the requirements of the Indian mineral industry.

It is definite that the mining industry needs an incentive to step up production. In fact the mining industry can make a substantial contribution towards the country's economic development. Under the circumstances, the industry could flourish through the joint effort of the private and the public sectors. Perhaps the working of the private sector under the supervision and guidance of the Government may prove an ideal arrangement for the time being.

APPENDIX

STATISTICAL TABLES

(Mineral Production of Selected Countries of the World)

TABLE NO.—87

WORLD PRODUCTION OF ANTIMONY ORE (Sb Content)

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Union of S. Africa	3.28	4.05	4.49	8.31	15.86	7.21	2.73	8.64	14.19	14.11	10.00
† Bolivia	10.86	12.26	10.28	8.78	11.82	9.81	5.78	5.22	5.36	5.11	6.35
Mexico	6.93	7.38	5.75	5.88	6.83	5.53	3.69	4.18	3.82	4.56	5.20
* Czechoslovakia	4.50	4.10	..	2.00	1.65	1.65	1.65	1.65	1.65	1.65	1.65
* China	1.91	3.25	4.00	6.00	7.00	8.00	10.00	10.90	11.80	11.80	15.00
Yugoslavia	1.36	2.25	2.79	3.21	1.97	2.24	1.86	2.31	2.34	2.50	2.56
Algeria	0.10	0.86	1.34	1.35	1.46	1.10	1.90	2.29	0.98	2.15	1.40
Australia	0.20	0.24	0.20	0.70	0.76	0.76	0.80	0.74	0.94	0.92	1.10
Peru	1.29	1.64	0.74	2.27	2.62	2.15	0.96	0.85	0.87	0.97	0.79
Canada	0.52	0.14	0.07	0.29	0.59	0.49	0.31	0.47	0.71	0.82	0.62
Japan	0.10	0.14	0.19	0.16	0.22	0.21	0.32	0.26	0.32	0.56	0.43
Italy	0.51	0.55	0.50	0.67	0.73	0.63	0.42	0.30	0.37	0.28	0.12
France	0.31	0.27	0.34	0.36	0.52	0.47	0.30	..	0.07	0.16	..
Austria	0.11	0.27	0.38	0.41	0.50	0.39	0.49	0.39	0.45	0.44	0.52

.. Not available.
* Estimate.
† Exports

TABLE NO.—88

WORLD PRODUCTION OF ARSENIC WHITE

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U.S.A.	17.05	16.95	11.61	12.04	14.69	14.22	9.86	11.97	9.80	11.45	9.54
Sweden	16.12	17.00	8.97	14.51	18.53	15.63	0.52	9.78	12.55	12.22	..
France	2.52	2.26	1.97	2.46	5.70	6.30	5.65	0.74	5.81	6.01	..
Mexico	9.71	7.59	3.58	8.98	12.79	2.87	2.00	2.44	2.96	2.65	4.61
Portugal	1.01	1.62	0.98	0.25	0.56	1.32	1.18	1.09	1.79	1.01	1.00
Belgium	..	0.15	0.53	1.92	0.33	1.01	1.73	1.80	2.07	2.78	3.00
Italy	1.63	1.74	1.45	0.73	1.77	2.01	1.07	1.13	1.06	1.07	1.63
Japan	1.41	1.77	2.01	1.33	1.38	1.41	1.44	1.44	1.74	1.66	1.63
Brazil	1.00	0.99	0.97	1.07	1.33	0.97	0.47	1.16	0.98	0.74	..

.. Not available.

TABLE NO. 89

WORLD PRODUCTION OF ASBESTOS

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Canada	600.4	650.3	521.5	794.1	882.9	843.0	826.6	838.3	965.1	920.1	962.9
Union of South Africa	27.3	41.5	64.1	79.3	97.4	121.4	86.0	99.0	108.6	123.8	142.9
South Rhodesia	49.1	62.3	72.2	64.9	70.5	77.0	79.6	72.6	95.5	108.0	119.9
U. S. A.	21.8	33.6	39.4	38.5	46.9	48.9	49.4	43.2	40.4	37.5	39.6
Swaziland	25.4	29.4	30.8	29.6	31.7	31.5	27.3	27.3	29.6	27.1	27.9
Italy	10.4	13.0	15.6	20.6	22.2	18.6	17.2	16.5	22.5	25.0	20.4
Cyprus	6.8	8.1	12.6	15.0	17.2	16.6	14.5	13.9	13.9	13.9	13.6
Japan	4.2	4.8	5.5	5.7	5.9	3.1	4.1	6.2	6.3	9.0	12.0

TABLE NO. 90

WORLD PRODUCTION OF BARYTES

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	802	706	663	629	767	918	836	842	1013	1229	1186
Germany West	46	60	181	311	417	346	304	384	415	413	407
Canada	117	87	43	70	89	108	225	201	231	292	197
Mexico (Exports)	..	..	..	..	..	11	57	52	107	214	373
Italy	69	66	52	54	77	55	72	74	104	937	103
U. S. S. R.	94	94	94	94	94	100	100	100	100	100	100
U. K.	96	124	119	98	90	71	70	74	84	77	82
Yugoslavia	..	29	36	30	25	35	81	104	99	65	79
Peru	7	2	6	3	23	9	15	11	9	51	121
France	54	57	30	33	27	29	40	47	64	47	50
Algeria	24	17	17	23	21	12	17	18	31	30	30
Japan	1	3	10	14	17	14	18	19	18	18	24

TABLE NO. 91

WORLD PRODUCTION OF BAUXITE AND ALUMINIUM

(a) Bauxite

Million Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
British Guiana	1.38	2.00	1.83	1.68	2.11	2.43	2.31	2.35	2.47	2.52	2.24
Surinam	1.74	1.98	2.16	2.05	2.70	3.17	3.27	3.36	3.12	2.49	3.38
Jamaica	..	..	..	..	..	0.42	1.24	2.10	2.71	3.26	4.71
U.S.A.	1.22	1.48	1.17	1.36	1.88	1.69	1.61	2.03	1.82	1.77	1.44
France	0.68	0.79	0.77	0.87	1.12	1.12	1.17	1.28	1.49	1.47	1.68
Hungary	0.34	0.48	0.56	0.58	0.75	1.21	1.40	1.26	1.24	0.89	0.92
Yugoslavia	0.09	0.14	0.35	0.21	0.50	0.61	0.48	0.69	0.79	0.88	0.89
Greece	0.02	0.04	0.05	0.08	0.16	0.29	0.33	0.35	0.50	0.70	0.83
Fr. W. Africa	..	..	0.01	0.01	..	0.11	0.35	0.43	0.49	0.45	0.37

.. Not available.

(b) Aluminium

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U. S. A.	519	565	548	652	759	850	1136	1325	1420	1523	1495	1431
Canada	271	333	335	360	405	453	498	506	556	563	505	545
France	53	65	54	61	91	106	112	120	130	150	160	169
Germany (West)	..	..	29	28	74	101	107	129	137	147	154	137
Italy	25	33	26	34	49	52	56	58	62	63	66	64
U. K.	29	31	31	30	28	29	31	32	25	28	30	27
Japan	3	7	21	25	37	43	45	53	58	66	70	85
Norway	22	31	35	45	50	51	53	61	72	92	96	121
Austria	5	13	15	18	26	37	50	57	68	71	73	74
Hungary	5	9	14	17	21	25	28	33	37	35	26	40
Switzerland	18	19	21	19	27	27	29	26	30	30	31	29

TABLE NO. 92

WORLD PRODUCTION OF BERYL

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
India**	..	..	..	..	0.22	0.55	0.18	0.35	0.77	3.05	1.15
Brazil	1.03	1.78	3.08	3.63	1.53	2.52	2.16	1.44	1.77	2.11	1.97
Argentina	0.01	0.05	..	..	..	0.50	1.37	0.64	1.35	1.56	1.38
Mozambique	0.08	0.02	0.14	0.26	0.23	0.21	0.25	0.91	0.87	0.85	1.70
Southern Rhodesia	..	..	0.02	0.85	1.01	1.08	1.61	0.98	0.88	0.56	0.52
U. S. A.	0.13	0.09	0.43	0.51	0.44	0.47	0.68	0.61	0.45	0.42	0.47
Madagascar	..	..	0.03	0.49	0.53	0.40	0.47	0.59	0.29	0.15	0.15
Belgian Congo	..	..	..	..	..	..	..	0.04	0.33	1.64	1.27
South West Africa	0.05	0.09	0.24	0.66	0.75	0.54	0.54	0.51	0.43	0.41	0.35
Union of South Africa	..	..	0.22	0.84	0.59	..	0.48	0.17	0.12	0.12	0.64

.. Not available.
** U.S.A. imports.

TABLE NO. 93

WORLD PRODUCTION OF BISMUTH

Thousand Pounds

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Mexico	563	339	681	579	744	893	739	796	774	1391	783
Peru	519	557	480	499	578	714	632	692	735	635	758
Korea	—	229	382	(a)	28	243	529	254	287	401	240
* Yugoslavia	95	112	84	133	193	218	217	242	230	245	220
* Canada	284	240	103	191	230	162	117	269	266	286	277
* Spain	46	53	44	25	33	27	56	33	48	139	210
France	111	123	130	172	130	190	159	24	70	142	141
Bolivia	196	77	18	54	152	35	138	101	95	100	84

* Metal production.

TABLE No. 94

WORLD PRODUCTION OF CADMIUM

Million Pounds

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	8.01	7.58	8.03	8.85	8.11	8.39	9.68	9.42	9.75	10.60	10.55
Mexico	1.72	2.00	1.81	1.52	1.97	1.62	2.11	1.13	2.86	1.89	1.58
Canada	0.72	0.77	0.85	0.85	1.33	0.95	1.12	1.09	1.92	2.34	2.34
S. W. Africa	..	1.44	1.66	1.34	1.43	1.11	1.19	1.62	1.40	2.33	2.84
Belgium	0.19	0.35	0.33	0.81	0.99	1.21	1.04	1.10	1.43	1.32	1.32
Japan	0.02	0.07	0.12	0.20	0.26	0.37	0.46	0.61	0.76	0.89	0.87
Australia	0.42	0.65	0.58	0.66	0.52	0.64	0.67	0.65	0.67	0.62	0.75

.. Not available

TABLE NO. 95

WORLD PRODUCTION OF CHROME ORE ($Cr_2 O_3$ contents)

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Turkey	50	140	217	207	295	395	438	270	312	400	470
Philippines	68	89	91	95	124	201	206	155	202	326	327
Union of S. Africa	172	186	184	225	247	261	324	285	240	278	296
Rhodesia South	76	125	150	175	144	154	202	193	196	196	314
U. S. A.	—	2	—	—	3	9	22	57	54	78	59
Iran	..	..	..	..	15	14	3	18	18	33	39
Yugoslavia	25	17	30	31	32	34	41	33	40	38	39
India	17	11	10	8	8	18	32	22	41	24	36
New Caledonia	25	37	44	42	43	53	60	42	23	24	32
Greece	1	1	1	5	10	13	15	11	10	19	18
Cuba	44	17	11	15	..	6	22	25	27	19	40
Japan	1	4	10	12	14	16	13	12	9	14	16
Pakistan	10	9	8	9	9	9	12	11	14	11	8

.. Not available.
— Less than 500 tons.

TABLE NO. 96

WORLD PRODUCTION OF COAL AND LIGNITE

(a) Coal

Million Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U. S. A.	621.4	592.9	433.2	505.3	519.9	457.6	440.3	379.2	442.4	477.1	467.6	382.9
U. K.	200.6	212.8	218.6	219.8	226.5	230.1	227.8	227.7	225.2	225.6	227.2	219.2
U. S. S. R.	132.3	150.0	169.1	185.2	202.5	215.0	224.3	243.7	276.6	303.7	328.4	*496.8
Germany West	71.2	87.3	103.8	111.1	119.9	24.8	125.7	129.1	131.8	135.6	134.4	132.6
Poland	59.1	70.3	74.1	78.0	82.0	84.4	88.7	91.6	94.4	95.1	94.1	95.0
France	45.2	43.3	51.2	50.8	53.0	55.4	52.6	54.4	53.3	55.1	56.8	57.7
India	30.6	30.7	32.2	32.8	35.0	36.9	36.6	37.5	38.8	40.0	44.2	46.1
Belgium	24.4	26.7	27.9	27.3	29.7	30.4	30.1	29.3	29.9	29.5	29.1	27.0
Japan	27.2	33.7	38.0	38.5	43.3	43.4	46.5	42.7	42.4	46.6	52.3	49.8
Union of South Africa	23.8	24.0	25.5	26.5	26.6	28.1	28.5	29.3	32.1	33.6	34.8	37.1
Czechoslovakia	16.2	17.7	17.0	18.5	18.4	20.3	20.3	21.6	22.1	23.4	24.2	25.8
Saar	10.5	12.6	14.3	15.1	16.3	16.2	16.4	16.8	17.3	17.1	16.5	15.4
Netherlands	10.1	11.0	11.7	12.3	12.4	12.5	12.3	12.1	11.9	11.8	11.4	11.9
Australia	15.1	15.0	14.3	16.8	17.9	19.7	18.7	20.1	19.6	19.6	20.1	20.6
Canada	13.0	15.3	15.6	15.4	14.9	14.1	12.6	11.6	11.4	11.4	9.9	8.5
Spain	10.5	10.4	10.6	11.0	11.3	12.0	12.2	12.4	12.4	12.8	13.9	14.4

* Includes lignite production also.

(Contd.)

(b)—Lignite

Million Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U. S. S. R.	51.0	58.2	66.4	75.9	79.5	85.8	96.1	103.4	114.6	125.2	134.9	*
Germany East	101.7	110.0	127.5	137.1	151.3	158.5	172.9	181.9	200.6	205.9	212.6	214.9
Germany West	58.8	65.1	72.5	75.9	83.4	83.5	84.7	87.9	96.4	95.4	97.2	95.6
Czechoslovakia	22.4	23.6	26.5	27.5	30.2	33.3	34.4	37.9	40.8	46.3	51.0	56.9
Yugoslavia	8.2	9.7	10.8	11.7	11.1	11.1	10.3	12.7	14.1	15.9	16.8	17.9
Hungary	7.8	9.4	10.5	11.9	13.7	16.8	19.0	19.1	19.6	18.2	18.9	21.6
Australia	6.2	6.8	7.5	7.4	7.9	8.2	8.4	9.5	10.3	10.7	10.9	11.9
Rumania	2.1	2.7	3.2	3.7	4.4	5.0	5.3	5.4	5.9	6.3	6.9	..
Bulgaria	4.2	4.1	5.1	5.8	6.2	7.2	8.1	8.6	9.8	10.4	11.5	..
Austria	2.8	3.3	3.8	4.3	5.0	5.2	5.6	6.3	6.6	6.7	6.9	6.5
Poland	4.8	5.0	4.6	4.8	4.9	5.1	5.6	5.9	6.0	6.2	6.0	7.5
U. S. A.	2.6	2.8	2.8	3.1	3.0	2.7	2.6	2.6	2.9	2.6	2.4	2.3
France	2.1	1.8	1.8	1.7	2.0	2.0	1.9	1.9	2.1	2.3	2.3	2.3
Canada	1.4	1.4	1.7	2.0	2.0	1.9	1.8	1.9	2.1	2.1	2.0	2.0
Japan	2.9	2.6	1.8	1.3	1.4	1.5	1.5	1.4	1.4	1.6	1.7	1.6

* Included in coal production (96—A)

.. Not available.

TABLE NO. 97

WORLD PRODUCTION OF COBALT ORE (Co Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Belgian Congo	3.59	3.60	4.40	5.15	5.72	6.83	8.28	8.61	8.57	9.08	8.12
North Rhodesia	0.39	0.40	0.52	0.66	0.71	0.50	0.85	1.08	0.67	1.04	1.32
Canada	0.26	0.70	0.28	0.27	0.43	0.65	0.73	1.02	1.51	1.60	1.70
U. S. A.	0.29	0.31	0.24	0.37	0.41	0.62	0.57	0.91	1.18	1.63	1.88
Finland	0.82	1.13	0.99	0.94	..	1.31	1.18	1.22	1.28	1.40	1.65
Morocco	0.37	0.27	0.21	0.42	0.72	1.00	0.64	0.74	0.76	0.64	0.46

.. Not available.

TABLE NO. 98

PRODUCTION OF COPPER ORE AND COPPER

(a)—Copper Ore (Copper Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	769	757	682	824	842	839	840	758	906	1004	985
Chile	427	445	371	363	381	409	362	364	434	490	486
Rhodesia North	196	217	263	281	314	317	368	385	348	390	423
Canada	209	223	239	240	245	234	230	275	296	321	309
Belgian Congo	151	156	141	176	192	206	214	225	235	250	242
Japan	22	26	33	39	43	54	59	66	73	79	82
Australia	13	13	15	18	18	19	37	42	46	53	58
Mexico	64	59	57	62	67	59	60	55	55	55	61
Peru	23	18	28	30	32	30	35	38	43	46	57
Union of South Africa	30	30	30	33	33	34	35	41	43	44	44
Philippines	3	2	6	10	13	13	13	14	18	27	40
Cyprus	12	11	20	16	18	20	21	22	27	32	34

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U. S. A.	857	840	780	915	940	929	951	858	1004	1117	1069	970
Chile	408	425	351	346	360	383	337	338	406	459	451	440
North Rhodesia	196	217	263	281	314	317	368	385	348	390	423	377
Belgian Congo	151	156	141	176	192	206	214	225	235	250	242	238
Canada	180	193	204	210	214	203	188	233	262	298	294	299
Japan	29	29	36	37	41	49	64	69	81	93	109	101
Mexico	59	49	49	49	59	51	52	44	45	47	61	65
Union of South Africa	29	29	30	33	33	35	35	42	44	46	46	49
Australia	14	11	10	16	15	20	35	39	38	50	52	66
Germany West	2	26	39	49	53	42	48	50	53	55	64	..
Peru	18	13	21	20	23	21	24	27	33	32	42	39
Finland	20	19	22	18	22	23	24	28	28	30	33	31
Yugoslavia	32	37	34	40	32	33	31	30	28	29	34	34
Turkey	10	11	11	12	18	23	24	25	24	25	24	23

.. Not available.

TABLE NO.—99

WORLD PRODUCTION OF DIAMONDS

(a) Gem. Quality

Million Carats

Country	1950	1951	1952	1953	1954	1955	1956	1957
Belgian Congo	10.15	10.57	11.61	12.58	12.62	13.04	14.01	15.65
Union of S. Africa	1.73	2.23	2.38	2.72	2.86	2.64	2.59	2.58
Ghana	1.14	1.76	2.13	2.16	2.13	2.28	2.52	2.93
South W. Africa	0.50	0.50	0.54	0.61	0.68	0.81	0.99	1.00
Angola	0.54	0.73	0.74	0.73	0.72	0.74	0.74	0.86
Fr. W. Africa	0.13	0.10	0.14	0.18	0.22	0.32	0.39	0.30
Sierra Leone	0.66	0.48	0.45	0.48	0.40	0.42	0.55	0.86
Tanganyika	0.16	0.11	0.14	0.17	0.33	0.33	0.36	0.39
Fr. Eq. Africa	0.11	0.15	0.16	0.14	0.15	0.14	0.15	0.11

(b) Industrial Quality

Belgian Congo	9.60	10.03	11.01	12.02	12.09	12.41	13.38	15.02
Ghana	..	..	2.02	2.04	1.99	2.11	2.35	2.65
Angola	0.28	0.32	0.31	0.31	0.30	0.30	0.30	0.35
Fr. W. Africa	0.10	0.08	0.11	0.12	0.14	0.21	0.26	0.15

.. Not available.

TABLE NO.—100

WORLD PRODUCTION OF FELDSPAR

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	467	468	375	414	407	428	470	420	470	705	620
West Germany	21	33	48	77	72	119	96	127	166	175	192
France	44	55	48	48	66	65	60	61	73	72	72
Japan	21	25	20	13	27	24	25	34	31	49	46
Italy	10	15	14	18	29	25	25	29	53	50	57
Norway	22	33	27	24	31	29	19	28	40	55	50
Sweden	38	39	39	36	41	48	38	49	51	53	50
Canada (Sales)	33	50	34	32	37	18	19	14	16	16	18
Australia	9	10	11	13	15	14	7	16	21	19	10

TABLE NO.—101

WORLD PRODUCTION OF FLUORITE

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	299	301	215	274	315	301	289	223	255	300	299
Germany (West)	19	49	47	93	144	157	162	174	155	146	140
*U.S.S.R.	75	75	75	75	75	75	80	100	100	150	150
U. K.	45	59	68	64	75	77	80	84	87	93	95
Italy	21	41	21	29	41	59	76	77	100	124	144
Spain	14	43	60	33	60	63	51	74	67	74	80
Canada	43	58	58	58	67	75	80	108	117	127	62
Mexico	46	75	56	66	67	188	156	133	182	327	354
Germany (East)	21	..	40	60	70	80	80	80	80	80	80
France	32	33	46	42	51	56	63	74	86	81	80

* Estimate

.. Not Available

TABLE NO.—102

WORLD PRODUCTION OF GOLD

Thousand Kilogrammes.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Union of South Africa	348.4	360.3	364.1	362.8	358.2	367.6	371.4	411.7	454.2	494.4	529.7
Canada	95.8	110.1	128.3	138.1	136.6	139.1	126.5	135.8	141.3	136.4	137.5
U. S. A.	67.4	63.0	59.8	71.2	59.9	59.9	61.3	57.8	58.4	58.0	56.0
Australia	29.2	27.5	27.7	26.8	27.9	30.6	33.5	34.8	32.6	32.1	33.7
Ghana	17.4	20.0	21.1	21.4	21.7	21.5	22.7	24.5	21.4	19.8	24.6
South Rhodesia	16.3	16.0	16.4	15.9	15.1	15.5	15.6	16.7	16.3	16.7	16.7
Belgian Congo	9.4	9.3	10.4	10.6	11.0	11.5	11.5	11.4	11.5	11.6	11.6
Mexico	14.5	11.4	12.6	12.7	12.2	14.3	15.0	12.0	11.9	10.9	10.8
Columbia	11.9	10.4	11.2	11.8	13.8	13.1	13.6	11.7	11.8	13.6	10.1
Philippines	2.0	6.5	9.0	10.4	12.2	14.6	14.9	12.9	13.0	12.6	11.8
Japan	2.1	3.1	4.1	4.8	5.9	7.1	8.0	9.4	9.0	9.2	9.4
India	5.3	5.6	5.1	6.1	7.0	7.9	6.9	7.5	6.6	6.5	5.6
Nicaragua	6.6	6.9	6.7	7.2	7.8	7.9	8.1	7.3	7.1	6.7	6.2
Peru	3.6	3.5	3.5	4.6	4.9	4.2	4.4	4.6	6.3	5.7	5.0

TABLE NO.—103

WORLD PRODUCTION OF GRAPHITE

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Korea	10.0	16.0	45.2	19.1	21.6	15.1	20.6	13.8	90.2	61.2	148.0
Mexico	28.3	35.3	23.8	24.6	32.3	24.2	30.3	21.7	29.4	29.7	23.6
Austria	3.8	11.3	14.4	14.7	18.2	19.7	14.7	17.4	17.9	18.7	18.9
Madagascar	5.2	7.7	9.1	14.0	18.3	18.5	13.3	12.1	15.8	15.8	16.0
Ceylon	9.2	14.2	12.4	13.0	12.8	7.8	7.3	7.8	10.1	9.3	8.3
U. S. A.	4.0	9.0	5.5	4.6	6.5	5.1	5.7	..	..	..	..
Japan	10.6	9.1	5.7	4.0	4.9	4.7	3.8	4.1	3.1	3.4	4.8
Czechoslovakia	7.0	15.0	..	..	..	..	..	..	..	..	..
Germany (West)	4.9	5.8	5.1	6.6	10.3	9.0	7.5	9.5	10.5	11.7	12.0
Italy	3.8	7.3	4.6	4.5	4.5	4.0	4.9	3.8	2.8	3.0	3.3
Canada	2.2	2.3	1.9	3.3	1.4	1.9	3.2	2.2	..	..	..

.. Not available.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	5.63	6.58	5.99	7.43	7.86	7.63	7.52	8.18	9.71	9.38	8.36
Canada	2.36	3.16	2.85	3.43	3.56	3.22	3.48	3.80	4.13	4.45	4.09
U. K.	1.77	2.12	2.14	2.24	2.32	2.43	2.60	2.81	2.97	3.39	3.38
France	2.23	2.25	2.14	1.99	2.02	2.00	2.90	3.19	3.65	3.60	3.51
Australia	0.22	0.28	0.32	0.34	0.37	2.21	2.39	2.54	2.88	3.00	3.00
U. S. S. R.	2.12	2.12	2.12	2.12	2.12	1.60	1.05	0.87	0.97	1.13	0.78
Spain	1.34	1.42	1.29	2.25	1.82	0.53	0.78	0.85	0.91	0.95	0.89
Germany West	0.15	0.32	0.52	0.76	0.81	0.60	0.67	0.71	0.74	0.79	0.80
Italy	0.30	0.38	0.45	0.49	0.58	0.42	0.59	0.62	0.70	0.87	0.93
India	0.05	0.08	0.14	0.21	0.21	0.36	0.33	0.45	0.48	0.44	0.49

TABLE NO.—105

WORLD PRODUCTION OF IRON ORES, PIG IRON AND CRUDE STEEL

(a) Iron Ores

Million Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
World Total	90.10	104.10	104.90	116.90	138.20	140.30	159.40	140.20	174.90	188.10	202.20
U. S. A.	47.71	50.89	43.29	49.31	60.12	50.01	60.47	39.95	53.63	51.17	55.42
U. S. S. R.	13.54	16.23	18.89	23.00	26.06	30.50	34.7	37.20	41.68	45.29	48.80
France	6.10	7.56	10.20	9.75	11.44	13.23	13.79	14.24	16.34	17.12	18.77
Sweden	5.57	8.21	8.43	8.28	9.25	10.12	12.18	9.29	10.45	11.30	11.92
Canada	1.72	1.40	1.84	1.80	2.34	2.63	3.25	3.67	3.13	11.15	11.11
U. K.	2.97	3.99	4.09	3.95	4.50	4.62	4.50	4.37	4.54	4.46	4.64
Germany (W)	1.05	1.79	1.25	2.81	3.24	3.73	3.40	3.14	3.73	3.96	4.27
India	1.63	1.48	1.82	1.93	2.38	2.55	2.46	2.68	2.83	2.99	3.12
Luxembourg	0.59	1.02	1.24	1.15	1.69	2.17	2.15	1.77	1.93	2.03	2.04
Brazil	0.42	1.07	1.28	1.35	1.64	2.15	2.46	2.09	2.30	2.78	2.72
Australia	1.44	1.36	0.93	1.44	1.63	1.91	2.17	2.31	2.34	2.58	2.51
Venezuela	..	..	..	0.13	0.81	1.26	1.47	3.47	5.40	7.11	9.84
Peru	..	..	..	..	..	..	0.56	1.12	1.02	1.56	2.08
Chile	1.08	1.68	1.66	1.77	1.96	1.43	1.72	1.31	0.94	1.50	1.61

Union of South Africa	0.72	0.70	0.75	0.72	0.86	1.09	1.23	1.19	1.26	1.31	1.32
Algeria	0.85	1.02	1.34	1.36	1.50	1.64	1.76	1.52	1.87	1.34	1.48
Liberia	..	..	..	..	0.12	0.61	0.98	1.09	1.16	1.44	1.34
Japan	0.26	0.29	0.41	0.49	0.62	0.74	0.92	0.90	0.86	1.10	1.22
Austria	0.28	0.36	0.46	0.59	0.75	0.84	0.87	0.85	0.89	1.02	1.09
Norway	0.08	0.13	0.18	0.19	0.21	0.50	0.76	0.70	0.81	0.99	0.98
Italy	0.12	0.28	0.28	0.23	0.29	0.43	0.51	0.56	0.69	0.83	0.78
Goa	..	..	..	0.06	0.24	0.27	0.52	0.76	1.22	1.48	1.74
Malaya	..	..	..	0.32	0.55	0.69	0.69	0.69	0.83	1.39	1.81
Philippines	..	0.01	0.21	0.32	0.49	0.66	0.68	0.81	0.82	0.79	0.75
Yugoslavia	0.34	0.38	0.40	0.35	0.28	0.32	0.38	0.54	0.67	0.83	0.90
Czechoslovakia	0.46	0.42	0.48	0.48	0.53	0.63	0.68	0.66	0.77	0.77	0.84
Morocco	0.60	0.68	0.71	0.73	0.82	0.87	0.84	0.73	0.77	0.94	1.05
Sierra Leone	0.51	0.58	0.66	0.71	0.70	0.70	0.85	0.51	0.78	0.82	0.84
Tunisia	0.20	0.38	0.38	0.41	0.49	0.53	0.57	0.52	0.63	0.65	0.65

.. Not available

(b) Pig Iron*

Million Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
World Total	98.2	112.5	115.2	132.7	148.5	150.6	166.0	156.6	188.8	196.3	205.7
U. S. A.	54.6	56.2	49.8	60.2	65.7	57.5	70.0	54.2	71.9	70.5	73.4
U. S. S. R.	11.2	13.7	16.4	17.2	21.9	25.1	27.4	30.0	33.3	35.8	37.0
U. K.	7.9	9.5	9.7	9.8	9.9	10.9	11.4	12.1	12.7	13.4	14.5
Germany West	2.3	4.7	7.2	9.5	10.8	13.0	11.7	12.6	16.6	17.6	18.5
Belgium	2.8	3.9	3.7	3.7	4.9	4.8	4.2	4.6	5.4	5.8	5.6
France	4.9	6.6	8.4	7.8	8.8	9.9	8.8	8.9	11.1	11.6	12.1
Japan	0.4	0.8	1.6	2.3	3.2	3.6	4.5	4.8	5.4	6.3	5.1
Canada	2.0	2.1	2.1	2.3	2.6	2.6	2.9	2.1	3.1	3.5	3.6
Saar	0.7	1.1	1.6	1.7	2.4	2.6	2.4	2.5	2.9	3.0	3.2
Czechoslovakia	1.4	1.6	1.8	2.0	2.1	2.3	2.8	2.8	3.0	3.3	3.6
Poland	0.9	1.1	1.4	1.5	1.6	1.8	2.4	2.7	3.1	3.5	3.7
Luxembourg	1.8	2.6	2.4	2.5	3.2	3.1	3.7	2.8	3.1	3.3	3.4
India	1.5	1.5	1.6	1.7	1.9	1.9	1.8	2.0	1.9	2.0	1.9
Australia	1.2	1.3	1.1	1.1	1.3	1.5	1.7	1.9	1.9	1.9	2.1
Austria	0.3	0.6	0.8	0.9	1.0	1.2	1.3	1.4	1.5	1.7	2.0
Union of S. Africa	0.6	0.7	0.7	0.7	0.8	1.1	1.2	1.2	1.3	1.4	1.4
Italy	0.4	0.5	0.4	0.6	1.0	1.2	7.3	1.3	1.7	2.0	2.2
Sweden	0.7	0.8	0.9	0.8	0.9	1.1	1.1	1.0	1.2	1.4	1.5

* Includes also ferroalloys.

(c) Crude Steel

Million Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
World Total	136.10	155.30	159.70	188.70	209.90	210.10	232.80	221.10	266.30	278.20	286.30
U. S. A.	77.02	80.41	70.74	87.85	95.44	84.52	101.25	80.11	106.17	104.52	102.25
U. S. S. R.	14.53	18.64	23.29	27.33	31.35	34.49	38.13	41.43	45.27	48.70	51.04
Germany West	3.06	5.56	9.16	12.12	13.51	15.81	15.42	17.43	21.34	23.19	24.51
U. K.	12.93	15.12	15.80	16.55	15.90	16.22	17.89	18.82	20.11	20.99	22.05
France	5.73	7.24	9.15	8.85	9.84	10.87	10.00	10.63	12.59	13.40	14.10
Japan	0.95	1.72	3.11	4.84	6.50	7.00	7.66	7.75	9.41	11.11	13.57
Belgium	2.88	3.92	3.85	3.78	5.05	5.07	4.50	4.97	5.85	6.38	6.28
Italy	1.69	2.13	2.06	2.36	3.06	3.53	3.50	4.21	5.40	5.91	6.79
Poland	1.58	1.96	2.30	2.52	2.79	3.18	3.60	3.95	4.43	5.01	5.30
Czechoslovakia	2.29	2.62	2.81	3.12	3.46	3.75	4.37	4.27	4.47	4.88	5.17
Canada	2.67	2.90	2.89	3.07	3.24	3.36	3.73	2.80	4.11	4.81	4.57

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Saar	0.71	1.23	1.76	1.90	2.60	2.82	2.68	2.81	3.17	3.37	3.47
Luxembourg	1.72	2.45	2.27	2.45	3.08	3.00	2.66	2.83	3.23	3.46	3.49
Germany East	..	0.31	..	1.00	1.55	1.88	2.16	2.33	2.51	2.74	2.89
Australia	1.36	1.40	1.23	1.26	1.50	1.58	1.86	2.18	2.24	2.36	2.82
Austria	0.36	0.65	0.84	0.95	1.03	1.06	1.28	1.65	1.82	2.08	2.51
Sweden	1.21	1.28	1.39	1.46	1.53	1.69	1.78	1.86	2.15	2.43	2.51
Union of South Africa	..	..	..	..	..	1.26	1.30	1.43	1.58	1.74	1.61
India	1.28	1.28	1.37	1.46	1.52	1.60	1.53	1.71	1.73	1.77	1.74
Brazil	0.39	0.48	0.62	0.77	0.84	0.89	1.02	1.15	1.16	1.38	1.60
Hungary	0.65	0.77	0.86	1.05	1.29	1.50	1.54	1.49	1.63	1.42	1.38
Spain	0.61	0.62	0.72	0.82	0.82	0.90	0.90	1.10	1.21	1.24	1.35
Netherlands	0.20	0.33	0.43	0.49	0.55	0.69	0.87	0.93	0.98	1.05	1.19

.. Not available.

TABLE NO.—106

WORLD PRODUCTION OF LEAD ORE AND LEAD

(a) Lead Ore (Pb. Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	349	354	371	391	352	354	311	295	307	320	307
Australia	200	220	217	229	215	232	274	289	301	309	339
Mexico	223	193	221	238	226	346	222	217	211	200	215
Canada	168	172	145	150	144	153	176	198	184	171	171
Peru	55	49	65	65	82	96	115	110	119	129	137
Morocco	22	29	37	49	69	85	80	83	89	89	92
Yugoslavia	52	63	72	79	80	79	85	84	90	87	90
Germany W.	15	22	41	45	50	52	63	67	67	65	71
Spain	30	31	30	40	41	43	55	57	63	61	65
South-West Africa	13	34	38	34	40	53	59	70	79	78	83
Bulgaria	..	7	9	11	18	29	42	55	52	61	78
Japan	5	7	9	11	13	18	19	23	26	29	57
Italy	24	30	36	39	40	41	44	44	48	51	55

(b) Lead

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U.S.A.	400	360	432	548	376	429	424	441	435	556	548	474
Mexico	218	187	212	230	214	237	214	207	209	191	214	200
Australia	191	193	187	200	201	197	210	241	228	240	243	254
Canada	147	145	133	155	147	166	150	151	135	134	130	121
Germany West	26	50	55	67	76	93	108	110	108	117	138	134
Yugoslavia	40	49	57	57	60	67	71	67	76	76	79	84
Belgium	41	66	79	63	73	80	76	72	83	102	99	96
Spain	32	22	27	35	41	42	49	56	61	59	63	71
France	35	35	55	61	48	52	55	61	67	63	74	71
Peru	34	35	37	32	44	50	59	58	61	60	69	64

.. Not available.

TABLE NO.—107

WORLD PRODUCTION OF MAGNESITE AND MAGNESIUM

(a) Magnesite

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Austria	223	412	528	551	665	463	736	342	596	623	616
U. S. A.	341	330	261	390	608	742	813	839	992	1084	1173
Yugoslavia	39	52	88	59	90	38	153	139	117	194	212
India	52	49	92	54	119	91	94	72	58	93	90
Greece	22	11	17	26	61	79	107	104	61	62	60
Australia	37	33	34	36	39	43	47	44	59	65	85
Spain	5	11	7	10	16	15	23	28	27	30	38
Union of South Africa	8	11	11	12	19	24	23	24	18	30	32

(b) Magnesium

U. S. A.	11.20	9.08	10.52	14.27	37.09	96.00	84.44	63.26	55.46	62.00	73.72
U. K.	2.25	2.45	2.65	3.05	4.98	4.71	5.40	5.06	5.46	3.69	3.47
Germany	—	—	—	0.87	4.48	3.70	3.36	3.33	4.15	3.69	4.23
Norway	—	—	—	0.30	—	0.30	3.50	4.70	6.70	7.63	8.62
Italy	—	—	—	0.20	0.12	0.98	1.45	1.67	2.87	3.73	3.77
France	0.76	0.64	0.49	0.45	0.37	1.09	1.08	1.15	1.52	1.54	1.58
Canada	0.14	..	..	1.61	4.00	5.00	6.00	6.00	7.00	8.72	7.35

.. Not available.
— Nil or negligible.

TABLE NO.—108

WORLD PRODUCTION OF MANGANESE ORE (Mn Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U.S.S.R.	900	1000	1300	1500	1900	2000	2100	2100	2100	..	..
India	215	253	310	425	611	691	897	670	677	720	692
Union of South Africa	121	116	275	332	319	351	333	286	220	248	253
Ghana	311	333	385	376	425	412	307	216	260	307	309
Brazil	81	79	102	36	90	110	102	72	94	137	351
Belgian Congo	4	6	6	9	36	64	108	193	231	165	184
Cuba	2	5	6	12	42	116	163	123	145	105	61
Morocco	42	85	98	115	157	188	175	162	169	174	188
U.S.A.	70	69	64	70	49	57	75	89	132	149	154
Japan	15	24	42	56	84	94	77	67	72	97	98
Rumania	9	18	20	23	18	21	29	43	93	58	66
Mexico	14	24	24	15	29	45	76	83	36	62	80
Goa	—	2	7	16	36	47	72	51	65	79	60
Egypt	—	17	40	44	45	55	82	51	63	60	86
Indonesia	—	—	—	—	—	45	12	11	21	43	28
Hungary	12	20	22	27	28	33	40	41	37	31	38
Turkey	3	4	11	16	25	39	44	24	25	30	28

— Nil or negligible.
.. Not available.

TABLE NO.—109

WORLD PRODUCTION OF MERCURY

Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Italy	1.86	1.32	1.54	1.84	1.86	1.93	1.77	1.88	1.85	2.14	2.18
Spain	1.92	0.78	1.11	1.79	1.53	1.35	1.50	1.49	1.25	1.66	..
Mexico	0.33	0.17	0.18	0.13	0.28	0.30	0.40	0.51	1.03	0.67	0.73
Yugoslavia	0.33	0.38	0.44	0.50	0.51	0.50	0.49	0.50	0.50	0.46	0.43
U.S.A.	0.80	0.50	0.34	0.16	0.25	0.43	0.49	0.64	0.65	0.83	1.15
Japan	0.06	0.06	0.09	0.05	0.06	0.11	0.22	0.35	0.19	0.20	0.17

.. Not available.

TABLE NO. 110

WORLD PRODUCTION OF MICA

(a) Blocks & Splittings

Metric Tons.

Country	1949	1950	1951	1952	1953	1954	1955	1956
India*	9479	12843	15576	7217	7296	6574	9673	9422
Madagascar	959	817	958	1069	816	526	271	539
U. S. A.	233	262	270	317	385	304	292	404
Canada	55	130	282	84	132	33	26	31
Tanganyika*	60	50	70	108	75	79	66	58
Southern Rhodesia	87	76	94	95	67	83	64	56

(b) Scrap & Ground

U. S. A.	29806	62922	65200	68253	66459	73700	86750	78460
India*	4164	3736	9351	8399	5220	10470	11580	12410
Canada	1530	1629	1969	828	900	753	720	500
Union of South Africa	1065	1357	1774	2663	1943	1870	3550	2290

..Not available.
* Exports.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	12.27	12.11	10.22	12.92	17.62	19.62	25.97	26.61	28.02	16.06	27.56
Chile	0.40	0.53	0.56	0.99	1.73	1.64	1.36	1.21	1.28	1.42	1.36
Yugoslavia	..	..	0.24	0.17	0.31	0.66	0.87	0.20	0.43	..	..
Canada	0.21	0.08	..	0.03	0.10	0.14	0.09	0.21	0.38	0.39	0.40
Japan	0.02	..	..	0.01	0.05	0.09	0.18	0.20	0.33	0.30	0.45
Norway	0.10	0.08	0.07	0.07	0.13	0.13	0.14	0.15	0.17	0.17	0.18

.. Not available.

TABLE NO. 112

WORLD PRODUCTION OF NICKEL ORE (Ni Content)

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Canada	107	120	117	112	125	128	130	151	159	162	171
New Caledonia	3	4	3	4	7	11	17	14	25	30	43
Cuba	2	..	..	..	..	8	13	13	14	15	22
U. S. A.	0.6	0.8	0.7	0.8	0.7	0.6	0.6	2.4	4.4	7.3	12.2

.. Not available.

TABLE NO. 113

WORLD PRODUCTION OF PETROLEUM (CRUDE)

Million Metric Tons

Country	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	234.32	250.95	273.01	148.92	166.71	303.75	309.45	318.54	312.85	335.74	353.72	353.63
U. S. S. R.	21.24	26.02	29.25	33.44	37.88	42.25	47.31	52.78	59.28	70.79	83.81	98.34
Venezuela	56.82	63.61	71.67	70.55	79.98	91.01	96.57	94.22	101.19	115.17	131.52	148.38
Saudi Arabia	8.20	12.30	19.08	23.24	26.65	37.12	40.31	41.17	46.46	47.03	48.20	48.36
Kuwait	0.90	2.20	6.40	12.30	17.29	28.23	37.64	43.29	47.72	54.76	54.98	57.29
Iraq	4.68	4.70	3.34	4.09	6.58	8.59	18.52	28.19	30.63	32.71	31.32	21.98
Iran	19.50	20.52	25.27	27.24	32.26	16.84	1.36	1.49	3.50	17.07	26.40	35.13
Rumania	4.19	3.81	4.15	4.70	5.05	6.20	7.90	9.10	9.80	10.56	10.92	11.18
Indonesia	0.30	1.11	4.33	5.93	6.41	7.45	8.52	10.23	10.77	11.79	12.73	15.47
Columbia	3.1	3.46	3.29	4.11	4.71	5.31	5.35	5.45	5.53	5.49	6.10	6.34
Argentina	2.98	3.13	3.32	3.23	3.36	3.50	3.55	4.08	4.23	4.37	4.44	4.86
Canada	0.97	0.98	1.60	2.82	3.88	6.44	8.28	10.93	12.98	17.49	23.24	24.54
Mexico	7.50	8.05	8.37	7.82	10.36	11.06	11.06	10.36	11.97	12.79	12.97	12.63
Brunei	0.29	1.73	2.69	.39	4.12	4.97	5.07	4.88	4.88	5.19	5.62	5.53
Qatar	..	..	..	0.10	1.64	2.37	3.30	4.06	4.78	5.44	5.88	6.61
Trinidad	2.94	2.99	2.93	3.01	3.02	3.03	3.09	3.20	3.38	3.56	4.14	4.88
Germany West	0.65	0.58	0.64	0.84	1.12	1.37	1.76	2.19	2.67	3.15	3.51	3.96
Peru	1.64	1.70	1.87	1.97	2.05	2.14	2.25	2.13	2.20	2.30	2.54	2.55

.. Not available.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	9.15	9.54	7.56	11.29	10.95	12.26	12.70	14.04	12.46	16.00	14.20
Morocco	2.88	3.23	3.69	3.87	4.72	3.95	4.10	5.02	5.33	5.52	5.57
Tunisia	1.75	1.86	1.44	1.53	1.68	2.27	1.72	1.82	2.20	2.08	2.07
Nauru	0.18	0.27	0.80	1.03	0.97	1.08	1.25	1.12	1.26	1.49	1.30
Egypt (U.A.R.)	0.38	0.30	0.35	0.40	0.50	0.53	0.48	0.53	0.65	0.62	0.59
Algeria	0.71	0.67	0.65	0.68	0.78	0.70	0.60	0.76	0.76	0.61	0.61

TABLE NO. 115

WORLD PRODUCTION OF POTASH (K_2O Content)

Million Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	0.81	1.03	0.97	1.17	1.51	1.51	1.73	1.77	1.89	1.97	2.06
Germany West	0.28	0.43	0.65	1.09	1.32	1.55	1.58	1.94	2.02	1.97	1.99
Germany East	..	0.94	..	1.34	1.41	1.35	1.38	1.46	1.55	1.56	1.60
France	0.60	0.77	0.67	1.02	0.99	1.06	1.03	1.24	1.35	1.50	1.58
Spain	0.17	0.15	0.17	0.18	0.20	0.21	0.22	0.24	0.35	0.42	0.40

TABLE NO. 116

WORLD PRODUCTION OF SALT

Million Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	14.56	14.88	14.13	15.09	18.33	17.73	18.86	18.75	20.60	21.97	21.64
U. K.	3.19	3.85	3.82	4.31	4.76	4.02	4.12	4.55	4.88	5.07	5.06
India	1.57	2.30	2.02	2.61	2.68	2.75	3.22	2.56	2.93	3.23	3.67
France	2.20	2.64	2.44	2.66	2.67	2.61	2.64	2.91	2.86	3.26	3.31
Germany W.	1.68	1.57	1.80	2.47	2.76	2.58	2.87	3.16	3.38	3.58	3.59
Italy	1.68	1.61	1.80	1.80	2:20	1.66	1.62	1.75	1.84	1.84	1.50
Poland	0.62	0.73	0.84	0.77	..	..	1.19	1.72	1.24	1.27	1.30
Canada	0.66	0.67	0.68	0.78	0.88	0.88	0.87	0.88	1.13	1.44	1.60
Japan	0.84	0.99	0.75	1.17	1.25	1.27	1.54	1.18	1.22	1.13	1.35

.. Not available.

TABLE NO. 117

WORLD PRODUCTION OF SILVER

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Mexico	1.83	1.79	1.54	1.53	1.36	1.57	1.46	1.24	1.49	1.34	1.47
U. S. A.	1.20	1.22	1.09	1.32	1.24	1.24	1.17	1.11	1.13	1.20	1.20
Peru	0.34	0.29	0.33	0.42	0.54	0.60	0.61	0.63	0.71	0.75	0.77
Canada	0.42	0.53	0.55	0.72	0.72	0.78	0.88	0.97	0.87	0.88	0.88
Australia	0.30	0.31	0.31	0.33	0.32	0.35	0.39	0.42	0.45	0.45	0.49
Bolivia	0.19	0.24	0.21	0.21	0.22	0.22	0.19	0.16	0.18	0.23	0.17
Belgian Congo	0.13	0.12	0.14	0.14	0.12	0.15	0.15	0.14	0.13	0.12	0.10
Japan	0.07	0.09	0.11	0.14	0.17	0.22	0.25	0.24	0.23	0.20	0.20
Yugoslavia	0.04	0.06	0.06	0.07	0.09	0.08	0.09	0.09	0.09	0.09	0.08
Sweden	0.03	0.04	0.04	0.04	0.04	0.07	0.06	0.07	0.08	0.08	0.08
Chile	0.02	0.03	0.02	0.03	0.04	0.04	0.05	0.05	0.05	0.06	0.05

TABLE NO. 118

WORLD PRODUCTION OF SULPHUR AND PYRITES

(a) Sulphur

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	4512	4947	4821	5276	5363	5378	5238	5604	5831	6537	5579
Italy	168	192	221	230	223	258	245	220	206	195	194
Japan	29	41	62	93	142	179	190	188	203	243	258
Chile	12	13	8	15	30	49	33	50	51	37	..
Mexico	3	3	5	13	11	12	13	73	492	771	1041

(b) Pyrites

Million Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Japan	0.88	1.44	1.54	1.93	2.35	2.63	2.34	2.68	2.74	3.10	3.38
Finland	0.52	0.56	0.62	0.65	0.71	0.72	0.87	1.17	1.30	1.38	1.49
Cyprus	0.44	0.41	0.67	0.61	0.72	0.97	0.96	0.80	0.98	1.10	1.10
U. S. A.	0.96	0.94	0.90	0.95	1.03	1.01	0.94	0.92	1.02	1.09	1.09
Spain	0.90	1.23	1.29	1.49	1.80	2.15	1.75	2.07	2.02	2.28	2.26
Italy	0.64	0.84	0.86	0.90	0.90	1.14	1.24	1.25	1.32	1.37	1.47
Canada	0.16	0.17	0.23	0.28	0.40	0.50	0.37	0.62	0.80	0.95	1.06
Germany W.	0.32	0.38	0.43	0.53	0.53	0.53	0.53	0.60	0.64	0.64	0.61
Norway	0.72	0.74	0.75	0.75	0.70	0.71	0.75	0.80	0.84	0.85	0.84
Portugal	0.39	0.56	0.62	0.61	0.73	0.76	0.65	0.58	0.67	0.67	0.67
Sweden	0.31	0.39	0.42	0.41	0.41	0.41	0.39	0.40	0.39	0.49	0.50

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	468	479	417	559	581	545	574	563	660	672	622
Japan	183	244	262	284	401	318	329	224	229	314	336
France	70	92	100	96	120	95	109	120	120	132	142
Austria	25	48	56	59	73	51	51	62	71	67	73
India	21	18	21	26	36	21	30	43	43	50	44
Norway	55	57	54	64	60	60	62	72	80	119	60
India	21	18	21	26	32	21	30	43	43	48	40
Germany West	20	28	31	13	20	28	30	33	36	36	30
Canada	24	26	24	30	23	24	24	25	24	26	30
Spain	32	30	38	25	36	18	18	21	23	28	29
Australia	6	6	9	10	13	8	10	13	13	14	15

TABLE NO. 120

WORLD PRODUCTION OF TIN CONCENTRATE AND TIN

(a) Tin Concentrate (Tin Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
Malaya	27.46	45.53	56.09	58.69	58.32	57.98	57.31	61.91	62.23	63.30	60.24	39.12
Indonesia	16.19	31.10	29.50	32.62	32.48	25.57	34.37	36.44	33.90	30.54	28.17	23.52
Bolivia	33.80	37.94	34.66	31.71	33.66	32.47	35.38	29.29	28.37	27.27	28.24	18.00
Belgian Congo	12.61	13.06	13.98	13.68	13.89	14.02	15.54	15.33	15.27	15.15	14.51	11.28
Thailand	1.42	4.31	7.94	10.53	9.65	9.63	10.29	9.94	11.20	12.68	13.75	7.80
China	4.40	4.90	4.30	4.10	4.90	5.50	6.40	7.60	8.50	8.50	9.80	..
Nigeria	9.28	9.38	8.97	8.39	8.68	8.45	8.35	8.05	8.29	9.31	9.37	6.36
Australia	2.49	1.92	1.92	1.88	1.58	1.64	1.58	2.11	2.05	2.11	1.98	..
Portugal	0.53	0.72	1.06	0.96	1.23	1.49	1.39	1.30	1.47	1.35	1.15	1.20
Union of S. Africa	0.49	0.46	0.48	0.65	0.77	0.95	1.38	1.34	1.31	1.46	1.48	..
U. S. A.	0.91	0.88	0.91	0.90	0.85	0.92	1.12	0.96	1.05	1.06	1.04	1.08
Burma	1.82	1.17	1.81	1.54	1.65	1.12	1.38	0.81	1.13	0.95	0.87	1.20
Japan	0.11	0.12	0.19	0.34	0.44	0.65	0.75	0.73	0.91	0.95	0.96	..
Spain	0.40	0.34	0.51	0.76	1.03	0.92	1.26	1.04	0.84	0.55	0.41	..
Germany East	0.11	0.16	0.16	0.19	0.29	0.40	0.57	0.68	0.68	0.67	0.68	..

.. Not available.

(b) Tin

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
Malaya	29.79	50.51	63.74	69.85	66.97	63.84	63.41	72.31	71.77	74.44	72.43	46.08
Netherlands	9.13	16.67	19.56	21.37	21.31	28.36	27.38	28.99	26.99	28.65	29.73	17.40
U. K.	28.53	31.50	28.84	28.95	18.10	30.00	29.32	27.92	27.68	26.86	34.72	33.12
U. U. A.	33.83	37.29	36.63	32.65	31.42	22.96	38.26	27.44	22.69	17.91	1.59	5.28
Belgium	12.25	10.64	9.14	9.67	8.49	10.76	9.18	11.56	10.60	9.87	10.03	8.38
China (Estimate)	4.40	4.90	4.30	4.10	4.90	5.50	6.40	7.60	8.50	8.50	9.80	..
Belgian Congo	3.13	3.94	3.30	3.29	3.06	2.81	2.76	2.50	3.08	2.82	2.69	2.64
Australia	2.42	1.91	1.99	2.05	1.48	1.73	1.47	2.10	2.04	1.88	1.84	2.16
Indonesia	..	..	0.50	0.41	0.22	0.23	0.65	1.37	1.80	1.52	1.80	2.16
Brazil	0.22	0.19	0.16	0.12	0.14	0.12	0.56	1.88	1.20	1.22	1.42	..
Portugal	0.38	0.29	0.22	0.21	0.32	0.35	0.48	0.63	1.03	1.15	1.09	..
Japan	0.04	0.05	0.29	0.40	0.58	0.65	0.82	0.83	0.94	1.18	1.28	..

.. Not available.

TABLE NO. 121

WORLD PRODUCTION OF TITANIUM MINERALS

(a) Ilmenite

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	305.3	348.1	365.0	424.9	486.1	479.5	466.0	498.0	530.3	622.7	688.3
India	265.1	233.1	313.1	216.1	227.7	228.5	263.6	244.8	255.3	341.1	301.4
Norway	69.7	90.0	99.0	105.2	105.2	118.3	128.3	19.44	158.2	191.0	210.6
Canada	6.4	4.0	0.5	3.2	19.2	38.3	132.9	113.9	149.3	202.7	244.9
Malaya (Exports)	13.3	12.9	20.0	25.3	44.2	22.1	27.0	45.5	54.7	124.3	93.4
Senegal	11.3	3.7	8.3	0.5	2.5	4.6	5.8	12.5	27.6	19.7	36.6
Finland	..	..	..	..	..	..	3.2	50.7	85.2	103.1	106.0

(b) Rutile

Australia	13.4	15.3	14.2	18.4	35.5	38.7	38.7	45.5	60.7	98.1	133.3
U. S. A.	7.8	6.7	10.9	6.5	6.0	6.4	6.2	6.7	7.7	10.9	9.7

.. Not available.

TABLE NO.—122

WORLD PRODUCTION OF TUNGSTEN ORE (WO_3 Content)

Thousand Metric Tons.

Country	1947	1948	1949	1959	1951	1952	1953	1954	1955	1956	1957
U. S. A.	1.68	2.31	1.66	2.27	3.38	4.14	5.30	7.53	9.06	8.44	4.59
China	4.14	7.32	5.40	7.20	9.50	12.00	10.20	10.80	10.80	10.80	12.00
Bolivia	1.58	1.49	1.53	1.48	1.63	2.22	2.30	2.67	3.23	2.86	2.62
Korea	0.78	0.87	0.91	0.53	0.75	2.54	4.99	3.24	2.04	2.43	2.49
Portugal	1.84	1.77	1.67	1.69	3.09	3.01	2.85	2.54	2.56	2.96	2.59
Australia	0.71	0.75	0.72	0.74	1.12	1.29	1.42	1.39	1.51	1.61	1.42
Belgian Congo	0.22	0.22	0.23	0.24	0.39	0.61	0.76	1.00	0.94	1.61	1.42
Canada	0.19	0.47	0.11	0.13	..	0.68	1.11	0.99	0.88	1.03	0.87
Spain	0.28	0.53	0.53	0.51	1.21	1.53	1.53	1.78	1.08	0.84	0.72
Argentina	0.05	0.10	0.10	0.01	0.02	0.33	0.42	0.60	0.60	0.66	0.74
France	0.24	0.33	0.42	0.27	0.46	0.57	0.67	0.56	0.54	0.65	0.56
Thailand	0.30	0.30	0.45	0.74	0.87	1.06	1.05	0.72	0.74	0.77	0.59
Mexico	0.05	0.08	0.04	0.04	0.20	0.27	0.41	0.33	0.34	0.34	0.16
Brazil	0.92	0.79	0.35	0.43	0.95	0.79	0.94	0.79	0.58	0.78	..
Burma	0.63	1.09	0.44	0.45	0.99	0.81	0.78	0.45	0.59	0.62	0.39
Peru	0.63	0.21	0.27	0.31	0.28	0.35	0.55	0.46	0.49	0.68	0.68
Japan	0.01	0.01	0.01	0.02	0.10	0.29	0.44	0.47	0.54	0.65	0.62

.. Not available.

TABLE NO. 123

WORLD PRODUCTION OF VANADIUM ORE (Vanadium Content)

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	0.96	0.81	1.44	2.09	2.76	3.26	4.21	4.47	4.52	5.11	6.62
South W. Africa	0.23	0.19	0.16	0.18	0.39	0.62	0.54	0.55	0.49	0.60	0.46
Peru	0.44	0.51	0.42	0.43	0.66	0.44	0.33	0.19	0.07	..	..
Northern Rhodesia	0.06	0.17	0.15	..	0.09	0.04	..	..	..	..	..

.. Not available.

TABLE NO.—124

WORLD PRODUCTION OF VERMICULITE

Thousand Metric Tons.

Country	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U. S. A.	125.77	153.15	188.78	189.61	189.92	172.30	176.85	185.49	175.11	167.30
Union of South Africa	12.53	21.20	42.42	24.51	36.29	30.77	41.48	52.25	53.38	56.74

TABLE NO.—125

WORLD PRODUCTION OF ZINC ORE AND ZINC

(a) Zinc Ore (Zinc Content)

Thousand Metric Tons

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
U.S.A.	578	571	538	565	618	604	497	430	467	492	482
Canada	229	252	262	284	310	227	227	224	269	249	243
Mexico	196	179	178	223	180	337	365	342	393	383	374
Australia	185	194	185	201	192	200	243	256	261	283	296
Japan	27	33	44	52	65	69	97	109	109	123	136
Peru	58	59	72	88	101	128	139	159	166	175	155
Belgian Congo	41	47	55	75	89	99	126	116	102	112	104
Italy	58	74	74	87	102	112	106	118	120	119	123
Poland	82	96	108	114	123	142	162	176	172	151	131
Germany (West)	22	29	58	70	75	81	91	94	92	92	94
Spain	43	47	52	62	76	86	84	88	92	87	81
Sweden	36	36	35	37	38	38	45	58	59	66	68
Yugoslavia	35	37	44	48	44	48	60	57	56	58	58

(b) Zinc

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958
U. S. A.	728	715	739	765	800	821	831	728	874	892	894	709
Canada	162	178	187	185	198	202	228	194	233	232	224	229
Belgium	133	154	177	177	201	187	193	213	212	231	236	215
Germany West	21	41	87	123	141	147	148	168	179	186	184	177
Poland	57	71	108	114	113	125	138	142	156	153	159	161
Japan	15	21	32	49	56	70	79	102	113	136	138	140
Australia	71	82	83	85	78	89	92	106	103	107	112	117
France	46	56	61	72	75	80	81	111	112	113	131	150
Italy	23	26	27	31	46	54	60	65	71	74	74	71
U. K.	69	73	65	71	71	70	74	83	83	83	78	76
Mexico	57	48	54	54	60	50	52	55	56	56	57	..
Rhodesia North	22	23	23	23	23	23	26	27	28	29	30	21
Norway	35	42	41	43	41	39	39	44	45	58	48	45
Netherlands	10	14	16	20	23	26	25	26	28	29	20	27

.. Not available.

TABLE NO. 126

WORLD PRODUCTION OF ZIRCONIUM CONCENTRATE

Thousand Metric Tons.

Country	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Australia	21.96	22.74	21.95	21.93	32.73	29.90	27.35	41.66	49.01	73.01	83.50
U. S. A.	..	..	..	..	..	..	21.71	14.84	25.55	39.98	..
Brazil	3.99	3.65	2.72	3.01	3.50	3.98	3.10	3.79	3.01	2.57	2.73
Egypt	..	0.09	0.13	0.09	..	0.12	0.24	0.10	0.12	0.36	0.36
French W. Africa	0.04	0.20	0.25	0.22	0.03	..	0.95	0.92	..	1.15	1.82

.. Not available.

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